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VOLUME XX JULY, 1937 NUMBER 7

ABSTRACTS OF PAPERS PRESENTED AT ANNUAL MEETING

GENERAL SESSION

The Preparation, Properties, and Use of Gonad-Stimulating Hormones. L. E. CASIDA, Dept. of Genetics, Univ. of Wisconsin.

A general discussion is presented having to do with sources of hormones, method of preparation, and physiological characterization of extracts from different sources. Attention is given to the problems involved in the use of gonad-stimulating hormones in dairy cattle. Variations in extracts and variations in responsiveness of cattle in different reproductive conditions make it difficult to control the end results of hormonal therapy. Emphasis is given to the study and classification of individual cases so that clinical entities may be recognized and their typical response determined.

XI World's Dairy Congress. J. C. MARQUARDT, New York Agricultural Experiment Station.

The Eleventh World's Dairy Congress will be held at Berlin from August 22 to 28, 1937. Like the previous ten Congresses it is sponsored by the International Dairy Federation. These Congresses have confined their place of meeting to continental Europe. One exception was the London Congress. The International Dairy Congress held in 1923 in Washington–Syracuse, U. S. A., was not sponsored by the International Dairy Federation.

It was my pleasure to be in Europe with the leaders of the XI Congress while plans were being formulated. This experience furnished a splendid chance to obtain authentic information on past and present plans for these gatherings. The main function of these meetings has been an attempt to formulate better understandings between scientific workers and the dairy industry of the various countries. Secondary is the opportunity for the host to show to advantage its dairy industry with its numerous appendages plus the country itself.

We are concerned mainly with the plan of the present Congress. It is essential to state that the various countries entertaining the Congress have used widely different means of reaching their objective. The program has ranged from a question box type discussion to the presentation of papers selected to be discussed by the authors. The XI Congress has aimed to have

papers presented so that the presentations fall into definite groups. A limited number of papers falling outside the restricted groups are being planned for by special sessions. It has been reported that 500 papers have been submitted.

It has been my pleasure to review some of the papers offered for presentation at the Congress and also to discuss them with workers on the continent and in Great Britain. From this experience it is my belief that more fundamental and new information will be given out at this than at any previous Congress. The proceedings of the Congress will be available in English, German, and French.

There are tours planned to the dairy sections and also to the dairy research institutes. The research institutes for dairying at Kiel and Weihenstephan have been remodeled and will be completely finished before the opening of the Congress. More than 280 workers are employed at Kiel, and Weihenstephan has a staff of more than 90 persons. In view of the fact that the men at Kiel work in the Dairy field only, the scope of the work is better appreciated by correlating this fact with the number of persons employed.

Trends and shifts in scientific work and technical services in Germany and continental Europe generally will be developments for citizens of our country to study.

An International Dairy Exposition will be held at the time of the Congress. This feature along with the further development of Congress rules, and a more exacting attitude toward a scientific board has greatly strengthened the work of the International Dairy Federation.

W. Clauss, Berlin S.W. 68, Lindenstrasse 28, Germany, is General Secretary of the XI Congress.

The Teacher Interprets Research. W. H. MORTON, Director Teacher Training and Chairman of Department of Secondary Education, Teachers College, University of Nebraska.

The dairy industry today is not suffering so much because of a lack of the right kind of tested scientific knowledge as because of the lack of use or application of such knowledge already known. The research specialist has been at work and the results of his labors are well known to men technically trained in the dairy industry. But a visit to the farms of this country will show that these scientific facts are either not known or at least are not practiced by those who own and operate them.

Here lies the pressing challenge to the leaders of the dairy industry.

1st. Facts, knowledge and skills must be discovered which will improve both the quantity and quality of dairy products. This may belong to research.

2nd. The research worker must next interest himself in helping those engaged in the dairy industry first, to understand the results of the testing

laboratories, and second, and perhaps as important as the first, to want to do something about them. In fact, his task is not done until he sees his tested ideas accepted and universally used.

This act of interpreting scientific knowledge to the uninitiated or layman and stirring within him the inner feeling to do something about it is the task for the teaching process.

It is not enough for scientific men to know the facts; they must be able to reveal them to others and then to inspire action.

To teach well means:

1. To stir up interest to cause a felt need on the part of the learner.
2. To lead him to discover a real problem—to find his progress thwarted.
3. To challenge the inquiring mind to examine the different factors present which may help to solve his difficulty.
4. To challenge the learner to draw tentative conclusions and later to test these conclusions in the field of reality.
5. And last, after having found a satisfactory answer to his problem, to build such attitudes within him that his future action will be changed and old practices will be discontinued and the newer and better way will be followed.

Each act which interprets the storehouse of knowledge in the dairy industry to those who know it not is a teaching act. It follows, therefore, that each member of this association is a teacher and the degree of success of his teaching should be measured by the degree to which the layman makes use of his ideas.

Current practices on the farms of this country show that there is much teaching yet to be done. To many farmers the scientific facts of dairying remain a closed book. There then is a dynamic challenge to teach the facts and inspire action until these bad conditions are eliminated.

Artificial Insemination—Demonstration. H. P. Davis and George W. Trimberger, University of Nebraska.

Artificial insemination has been extensively practiced with horses, but because of the difficulties of obtaining the semen and of keeping the spermatozoa alive under ordinary conditions away from the cow for more than a few hours, it has not been widely used with cattle. Artificial insemination has been used with dairy cattle at this institution for about two years with excellent results. The semen may be obtained by the service of a cow, either one in heat or one that will accept the bull, or by the technique suggested by Miller and Evans.[1] If cows are used it is essential that they have a normal reproductive record and be free from all infections. The method of Miller and Evans[1] is to be preferred since once the technique is mastered it allows

[1] Miller, Fred W., and Evans, E. I., Technique for Obtaining Spermatozoa for Physiological Dairy Studies and Artificial Insemination, Jour. Agr. Res. 84: 941–947.

for a better sample and eliminates the danger of infections from the cow. So far a complete report is possible on 34 cows. These cows were given 62 services and there were 31 conceptions. Two cows had two calves each, and five cows did not conceive. Of the 31 conceptions, 23 were from the first service, 5 from the second, 2 from the third and one from the fourth service. This record covers cows affected with Bang's disease and trichomoniasis. With the improved technique now used, out of 47 manipulations since January 1, 1937, on twelve different bulls, 46 satisfactory samples have been obtained. Care is used in collecting and handling semen to keep it from being contaminated with urine. This is done by emptying the bladder by exerting pressure with the hand through the intestinal wall and then irrigating the sheath with sterile water. A liberal supply of sterile test tubes and several funnels is advisable in order to allow frequent switching of tubes by the assistant to prevent contamination while collecting the sample of semen. A long-handled stick with a clamp for holding the test tube is a great convenience. Best results appear to be possible when metal does not come in contact with the semen. A special 15-inch vaginal speculum, an 18-inch capillary tube attached to a 5 cc. glass syringe, and a flash light provide the other equipment used. The advantages of artificial insemination are:

1. It permits the use of a bull on a large number of cows without injuring his efficiency.
2. It prevents the spread of any infection from cow to cow.
3. It provides for the use of a bull over a much wider geographical area.
4. It permits the examination of semen before service.
5. It prevents mechanical difficulties at breeding such as a closed cervix.
6. The size factor in mating is eliminated.

PRODUCTION SECTION

P1. A Study of the Methods of Sampling Milk for Butterfat Tests Where a Combine Milker Is Used. K. S. Morrow and H. C. Moore, University of New Hampshire.

Rules for the conduct of official and herd tests adopted by the American Dairy Science Association provide that where combine milkers are used samples may be drawn directly from the glass milk holder. Mixing of the milk for sampling is dependent upon agitation by the inflow of air when the valve at the bottom of the jar is opened. In herds where stripping by hand following the combine milking is practiced, such strippings obviously are not included in the sample taken for testing.

Samples of a few preliminary trials in the University of New Hampshire dairy herd indicated that there were occasionally marked differences in the test of milk drawn directly from the combine milk jar in comparison with

TABLE 1

Variation in butterfat test of samples taken by different methods. Method No. 1 used as the standard

AMOUNT OF VARIATION	NUMBER OF CASES BY BREEDS									
	Method 1 and 2					Method 1 and 3				
	Ayr.	Guer.	Hol.	Jer.	Total	Ayr.	Guer.	Hol.	Jer.	Total
% fat										
−0.10				1	1					
0.00	12	13	36	12	73	3	3	15	2	23
+0.05	1	1	3		5	2		1	1	4
0.10	13	7	17	10	47	8	6	18	7	39
0.15			1		1	1	2	2	1	6
0.20	2	3	4	2	11	8	7	19	6	40
0.25				1	1		2	1		3
0.30		2		2	4	4	3	3	4	14
0.40		1	4		5	1	1	4	3	9
0.50			2		2		3	2	3	8
0.60								2	1	3
0.70			1	1	2	1				1
0.80								1		1
0.90									1	1
1.00										
1.10				1	1					
1.20				2	2					
1.30			1		1			1	2	3
1.40			1		1					
1.50									1	1
1.60								1		1
TOTAL	28	27	70	32	157	28	27	70	32	157
NUMBER SHOWING NO CHANGES	12	13	36	12	73	3	3	15	2	23

TABLE 2

Comparative butterfat and solids-not-fat tests of samples taken by different methods

BREED	NO. OF CASES	METHOD NO. 1			NO. 2			NO. 3			VARIATION IN TEST				WEIGHT OF STRIPPINGS
		Milk	Fat	S.N.F.	Milk	Fat	S.N.F.	Milk	Fat	S.N.F.	2 WITH 1		3 WITH 1		
		lbs.	%	%	*lbs.*	%	%	*lbs.*	%	%	*% fat*	*% S.N.F.*	*% fat*	*% S.N.F.*	*lbs.*
AYR.	28	12.25	4.03	9.05	12.25	4.12	9.01	12.67	4.21	9.00	+0.09	−0.04	+0.18	−0.05	0.41
GUER.	27	11.51	5.12	9.20	11.51	5.21	9.18	11.86	5.33	9.17	+0.09	−0.02	+0.21	−0.03	0.34
HOL.	70	20.29	3.29	8.17	20.29	3.41	8.16	20.80	3.49	8.16	+0.12	−0.01	+0.20	−0.01	0.46
JER.	32	9.84	5.09	9.36	9.84	5.28	9.35	10.28	5.45	9.31	+0.19	−0.01	+0.36	−0.05	0.44
AVE.	157	15.22	4.10	8.75	15.22	4.23	8.73	15.65	4.33	8.72	+0.13	−0.02	+0.23	−0.03	0.43

the milk when sampled after being drawn into a separate container and thoroughly mixed. Since the average daily production of the cows was almost twice that of animals reported in a similar trial by Missouri in 1933, and with a larger proportion of strippings than they reported, it was deemed advisable to make a comparison of the methods of sampling from the combine milker in the University herd.

Methods used were: Method No. 1—sample taken directly from glass jar; Method No. 2—sample taken from milk after being drawn from jar and thoroughly mixed; Method No. 3—sample taken after thorough mixing of combine milk with hand strippings added. The butterfat was determined by the Babcock test. Total solids also were run on each sample by the Mojonnier test, the solids-not-fat determination serving as a check on the accuracy of the fat test.

Table 1 shows a distribution of the variation in test of 157 samples. For the entire group 46.5 per cent of the samples by Method No. 2 showed no change in comparison with samples taken directly from the jar. In only one case was the test lower by the No. 2 method. When the strippings were added to the milk before sampling, the test was increased in 85.4 per cent of the samples.

The comparative butterfat and solids-not-fat tests and the amounts of milk produced are given in Table 2. Both tables indicate a breed difference in the variation between the three methods of sampling for butterfat test under the conditions of the trial. The thorough mixing of the sample in contrast to taking directly from the jar increased the fat test in 52.8 per cent of the cases. This increase is not significant and substantiates the findings of previous investigation. The very slight variation in solids-not-fat test for the three methods substantiates the accuracy of the butterfat test obtained on the samples. For the determination of solids-not-fat either method gave reliable analysis. The value of including the strippings before sampling is still a debatable one. Using the tests as listed in Table 2, the fat production credits of the individual cows in the University of New Hampshire herd in 1935–36 would have been increased as follows if Method No. 3 had been used in place of Method No. 1—Ayrshires 10.8 lbs. Guernseys 11.4 lbs., Holsteins 22.5 lbs., Jerseys 25.2 lbs.

P2. Changes Occurring in Freshening Dates from Year to Year of Cows in Iowa Testing Associations. C. Y. Cannon and D. L. Espe, Iowa State College.

Previous studies of data from testing associations of the United States show that cows which freshen in the fall produce a higher average yield of milk than cows which freshen in other seasons of the year. This has been publicized widely through extension agencies and should have influenced dairy farmers to breed their cows for fall freshening. If such a shift in

freshening dates occurred it should be shown in the records of the cow testing associations.

The available records of the Iowa Cow Testing Associations covering ten years (1926–1935 inclusive) disclosed a total of 131,135 cows with known calving dates. When these were sorted by months and by years in which the freshening occurred they showed that very little change occurred in the percentages of cows that freshened each month from year to year. During the ten years the calving distribution seems to have shifted slightly from the winter and spring to the summer and fall seasons though in 1935 the shift was in the opposite direction. Samples of these data show no significant relation between age of cow and time of calving. An estimated calving interval of approximately 454 days for all cows in the cow testing associations during the ten years indicates that apparent shifts in calving time which occurred are probably the result of factors not entirely under the control of the dairymen.

P3. A New Visible System of Dairy Herd Books. F. W. Atkeson and H. W. Cave, Kansas Agricultural Experiment Station.

After study of many types of forms for keeping dairy herd records, new forms and a visible type of binding has been evolved. The forms are smaller ($7\ 5/8'' \times 14''$) than most herd books and yet are more complete. An effort was made to prepare forms that not only present the usual data on production and reproduction, but in addition complete records on breeding, breeding efficiency, disease history, and treatment.

The record system consists of four sheets of two forms each (front and back). Title of each sheet implies its use; individual cow record, continuous sire record, yearly herd summary, and annual herd inventory. Each form is so prepared that a summary of the most essential data is presented at the bottom of the sheet and the binding system exposes this bottom edge of each sheet.

This system represents the loose leaf system of binding making possible the keeping of the active herd in the visible type binder and the animals removed from the herd in another binder.

Some of the advantages of the system suggested are: all essential information is presented in tabular form on all animals in the herd; no index is needed; the animals may be arranged in convenient groups such as open cows, pregnant cows, heifers of breeding age, and heifers less than breeding age; these groups can be arranged in order of breeding dates, freshening dates, etc.; a ready inventory is presented of the number of cows bred to certain bulls, number of daughters of certain bulls, etc.

Two types of binders are suggested, the "Shif-Dex" for large herds and a special ring binder for smaller herds.

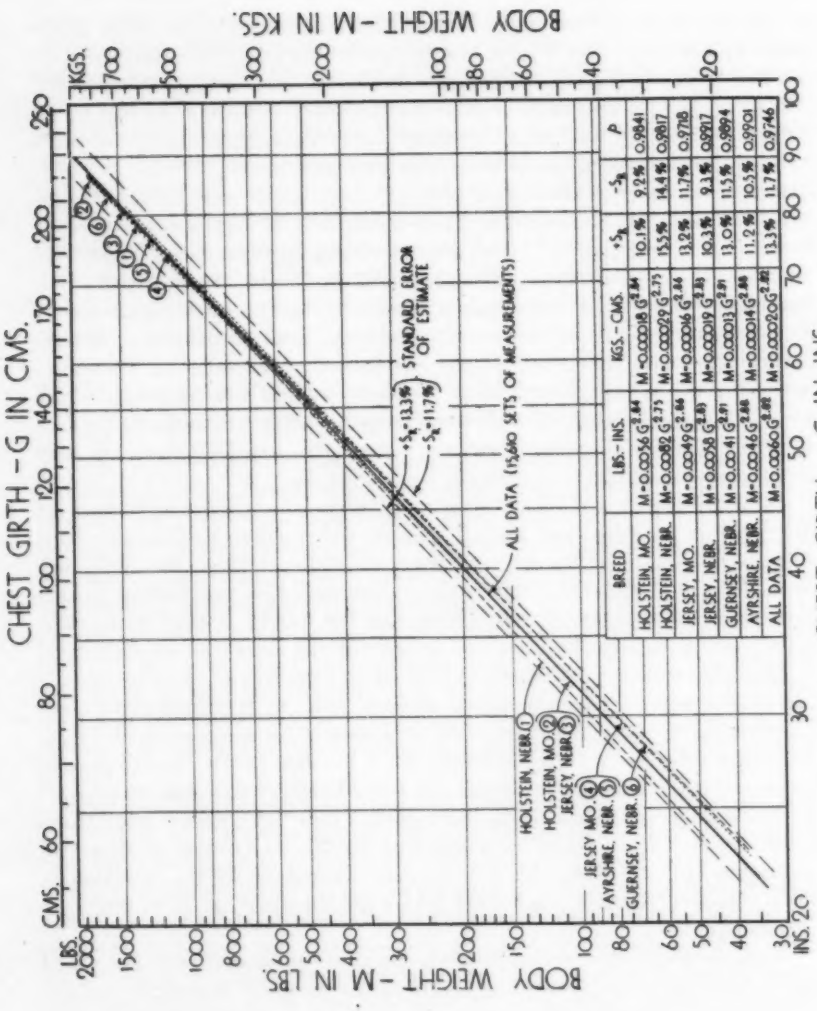
P4. Estimating Live Weight from Chest Girth of Dairy Cattle of Unknown Age.* S. BRODY, H. P. DAVIS AND A. C. RAGSDALE, Missouri and Nebraska Agricultural Experiment Stations.

The size of an animal may be interpreted in relation to the parts which make up the body as a whole, and in relation to age. This statement of organic interrelatedness practically constitutes what may be termed the "field" theory of growth, structure, and function. Many years ago C. H. Eckles, at the Missouri Station, initiated an investigation on growth of dairy cattle apparently with the idea of ultimately interpreting the interrelatedness of 21 linear measurements, weight, age, feed supply, etc. Eckles' successors at the Missouri Station made many attempts to integrate his growth data by a "unified field theory." (See, among others, Missouri Agric. Expt. Station Res. Buls. 67, 1924; 80, 1925; 103, 1927.) It was demonstrated (Res. Bul. 103) that the interrelations between practically every one of the 21 Eckles measurements and body weight follow a constant pattern or design, and that this pattern can be formally represented by the equation $Y = bX^n$ in which Y is the magnitude of a given measurement and X is the weight of the body. The concrete meaning of the applicability of this equation to the data is simple: thus if n in the equation is 2, then the *percentage* increase in Y is 2 times as great as the *percentage* increase in X.

This field equation, which apparently represents the basic pattern of development of form, was first applied to the prediction of weight from linear size in work at the Missouri Station (Missouri Expt. Sta. Res. Bulletins 141, 1930, and 142, 1930); later it was embodied in a formal prediction table (Ragsdale and Brody, Estimating live weight of dairy cattle, Missouri Station Bulletin 354, 1935). At roughly the same time a similar prediction table was derived independently by an arbitrary procedure (tracing free-hand a curve through weight-chest girth data) by Kendrick and Parker (Estimating the weight of dairy cows from heart-girth measurements. U. S. Dept. Agr., Bureau of Dairy Industry, B. D. I.—695, 1936). In the present paper we introduce what we shall call the "Missouri-Nebraska Standard" for estimating live weight from chest girth. This "standard," generalized by the above "field" equation, is based on 15,610 sets of chest girth-weight measurements. Of these, 10,921 sets were secured under the direction of H. P. Davis (Nebraska) and 4689 under the direction of A. C. Ragsdale (Missouri).

Data on which the present paper is based are presented with the aid of charts indicating the nature and utility of the proposed standard. One of these charts, presented herewith, shows that the *formal relation* between weight, W, and the chest girth, G, is $W = bG^n$; and that the *numerical value*

* Paper 130 in the Herman Frasch Foundation Series. Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 515.



BREED	LBS. – INS.	KGS. – CMS.	$+S_x$	$-S_x$	ρ
HOLSTEIN, MO.	$M=0.0036\,G^{2.84}$	$M=0.00018\,G^{2.84}$	10.1%	9.2%	0.9841
HOLSTEIN, NEBR.	$M=0.0082\,G^{2.75}$	$M=0.00029\,G^{2.75}$	15.5%	14.4%	0.9817
JERSEY, MO.	$M=0.0049\,G^{2.86}$	$M=0.00006\,G^{2.86}$	13.2%	11.7%	0.9768
JERSEY, NEBR.	$M=0.0058\,G^{2.83}$	$M=0.00019\,G^{2.83}$	10.3%	9.1%	0.9917
GUERNSEY, NEBR.	$M=0.0041\,G^{2.91}$	$M=0.00013\,G^{2.91}$	13.0%	11.5%	0.9894
AYRSHIRE, NEBR.	$M=0.0046\,G^{2.86}$	$M=0.00014\,G^{2.86}$	11.2%	10.5%	0.9901
ALL DATA	$M=0.0060\,G^{2.82}$	$M=0.00020\,G^{2.82}$	13.3%	11.7%	0.9746

of n in 2.82, of the standard error of estimate of all the 15,160 sets of measurements and the equation is +13.3% and −11.7%, and of the index of correlation is 0.9746. The meaning of 2.82 is that the *percentage* increase in weight is 2.82 times as rapid as the *percentage* increase in chest girth; of +13.3 and −11.7, is that 2/3 of all the 15,610 sets of measurements are within +13.3% and −11.7% of the computed average curve.

P5. Is the Calcium: Phosphorus Ratio of Common Mineral Mixtures Suited to Dairy Cattle? G. BOHSTEDT, University of Wisconsin.

Most mineral mixtures used for dairy cattle in north central states have a greater excess of calcuim over phosphorus than is physiologically correct. A common relationship of these two elements in both home-mixed and commercial mineral mixtures is the presence of 4 to 8 parts of calcium for every 1 part phosphorus, by weight. This means that such mixtures contain fully as much, frequently two to three times as much, ground limestone as bone meal, or minerals equivalent to these two typical mineral feeds. It is suggested that this relationship is an illogical one for dairy cattle that, if in need of additional minerals at all, are primarily in need of phosphorus rather than calcium. The frequent occurrences of pica or phosphorus deficiency diseases of cattle in various countries are abundant proof of this. On the other hand there are no widespread corresponding occurrences of calcium deficiencies in cattle, and recent work at Minnesota has shown that dairy cattle may grow, reproduce, and produce milk successfully on rations that are low in calcium. While it is recognized that the need of dairy cattle for calcium must be met, this element in practical rations is not apt to be as critical an element as is phosphorus.

It has been demonstrated by U. S. D. A. workers that a favorable Ca : P ratio in dairy cattle rations is less than 2 parts calcium for every 1 part phosphorus, by weight. In case of a phosphorus deficiency, it is obviously impossible to correct it and still have the ration remain at or below the 2Ca : 1P ratio by feeding mineral mixtures that have from 4 to 8 parts calcium to every 1 part phosphorus. That this is what dairymen are doing, or are asked to do, is proved by the situation in Wisconsin which is also typical for neighboring states. For the year 1937 there are 47 mineral manufacturers in Wisconsin and 5 other states who have registered their products with the State Department of Agriculture and Markets. Of the 47 firms, 4 have as their entire output non-phosphate minerals, or therefore primarily limestone and oyster shells. One firm produces dicalcium phosphate. Six have mineral mixtures for cattle which mixtures on the basis of their guarantee have a calcium : phosphorus ratio averaging 2.7 : 1, and varying from 2.0 : 1 to 3.4 : 1. But the remaining 36 firms, or therefore the vast majority, prepare and sell cattle mineral mixtures with a calcium : phosphorus ratio averaging 5.9 : 1, with a range of 4.1 : 1 to 11.3 : 1. Thus even the lower ratio represents

mixtures having as much as 1 part high calcium limestone to 1 part steamed bone meal.

It is pointed out that wheat bran, linseed meal, cottonseed meal or similar protein concentrates in dairy rations in large part take care of the need for phosphorus. If the use of such feeds is not called for in practical rations and if the roughage has been grown on phosphorus-poor soil, it may be advisable to use a suitable grade of bone meal, bone black, rock phosphate (with fluorine removed), or other phosphates having 1 part or more phosphorus for every 2 parts calcium.

P6. The Essentiality of Cobalt in Bovine Nutrition. W. M. NEAL AND C. F. AHMANN, Florida Agricultural Experiment Station.

A condition of malnutrition has been encountered in controlled feeding trials with calves on a ration of Natal grass (*Tricholena rosea*) hay, shelled corn and dried skimmilk that may be prevented or overcome by the use of a cobalt supplement. None of these feeds showed the presence of cobalt upon spectrographic examination. This deficiency occurs on certain soil types (not all determined) and may or may not overlap a nutritional anemia that responds to iron and copper supplement. However, in the experiments to be reported, the use of ferric ammonium citrate and copper sulfate aggravates the condition unless cobalt is administered also.

Affected animals show a long and rough hair coat, scaliness of the skin, listlessness, retarded development of sexual characteristics, gauntness due to loss of appetite, and muscular atrophy. The erythrocyte count may be above average, and the hemoglobin concentration equal to or above that in animals receiving cobalt and making normal growth. The amount of hemoglobin per erythrocyte, or per volume of erythrocytes, is reduced. The condition would be classed as a *microcytic hypochromic anemia.* The spleen is shriveled and fibrous and the heart of normal size but very flabby.

No polycythemia has been encountered at the rates (5.0–10.0 mgs. per animal per day) at which cobalt has been given.

Examples of growth rates are shown in Figure 1. E-79, receiving 5 mgs. cobalt per day, made uniform gains until he weighed over 550 pounds. Irregularities in his growth curve, and that of E-74 at the higher weights may be attributed to a marginal cobalt intake, or to an additional undetermined deficiency. That cobalt intake may have been marginal is shown by the increased growth of E-86 when the cobalt intake was increased. E-86, receiving cobalt, weighed 85 pounds more than E-85 on the check ration at 14 months of age, and the differences in physical appearance were even more striking. The retarded growth, due to the use of ferric ammonium citrate and copper sulfate, is shown in the curves for E-74, E-87, E-78 and E-73. No animal has been raised to a weight of over 450 pounds on this ration of Natal grass hay, shelled corn and dried skimmilk without the use of a cobalt supplement.

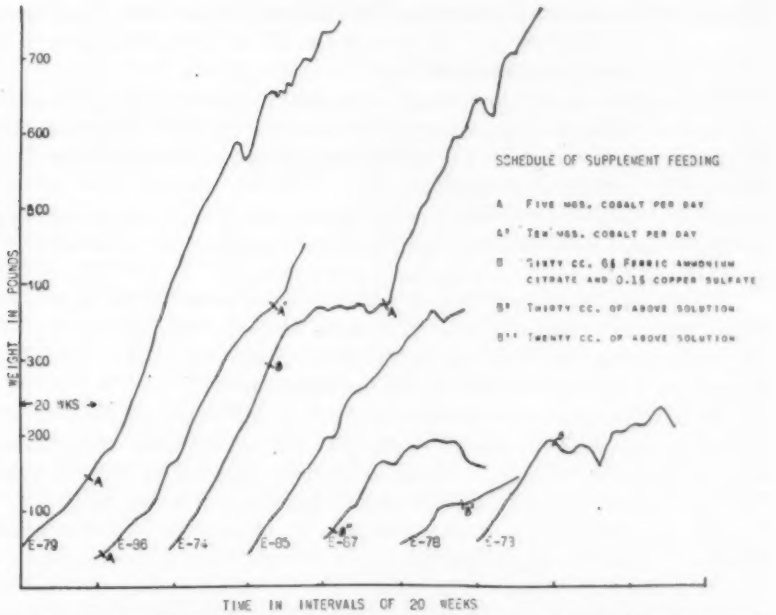


FIG. 1. Growth of calves showing the effect of cobalt, and iron and copper supplements, with a ration of Natal grass hay, shelled corn and dried skimmilk, the hay and corn being produced on deficient land.

P7. Fermentation Energy Losses in Dairy Cattle.* L. E. WASHBURN, Missouri Agricultural Experiment Station.

Rumen and expired gases of a dairy cow were measured simultaneously at different times after feeding. The results indicate that, contrary to the commonly accepted opinion, the ratio between fermentation carbon dioxide and combustible gases is subject to a considerable but characteristic variation. Expired fermentation carbon dioxide computed from the above ratio and uncorrected for salivary carbon dioxide not only necessitated a reduction in the respiratory quotient (0.007 to 0.465—depending on feed and time after feeding), but also represented a carbon loss equivalent to 835–1749 Calories in a 24-hour period. Total energy losses in fermentation carbon dioxide and combustible gases were calculated to amount to 12 to 16 per cent of the feed energy intake, or 25 to 40 per cent of the maintenance requirement. Rumen oxygen and nitrogen values showed that aerobic influence is undoubtedly present, though not appreciable. As digestion proceeded, the rumen gases tended to approach values comparable to intestinal gases.

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P8. Acetonemia and Ketonuria in Dairy Cows under Farm Conditions. C. W. DUNCAN, C. F. HUFFMAN AND H. A. TOBIN, Michigan Agricultural Experiment Station.

This report is based upon a study of some of the constituents in the blood and urine of a herd of purebred Jersey cows, all of which were suffering from acetonemia. The ration consisted principally of poor quality soy bean hay, grain mixture and corn silage.

All of the cows had calved normally within two to six weeks of the onset of the disease. The milk yield soon dropped markedly, the cows lost their appetite and have taken on a haggard appearance.

The average value for "acetone bodies" in the blood of the eight cows before treatment was 25.8 mg. per 100 cc., the limits of variation being 2.64 mg. to 79.05 mg. At the end of the three weeks these same values had dropped to 2.87, 0.93 and 6.20 mg. respectively.

The average value for "acetone bodies" in the urine, collected at the same time as the blood, was 167.4 mg. per 100 cc., the limits of variation being 20.3 mg. to 549.5 mg. These same values dropped to 41.1, 14.4 and 76.2 mg. respectively, within three weeks from the time of treatment.

Milk samples from five of the most severely affected cows also contained "acetone bodies" varying from 5.0 mg. to 42.9 mg. per 100 cc. of milk.

The carbon dioxide combining capacity of the blood plasma increased to a slight extent during the treatment (58.0 vol. to 62.2 vol. per cent, mean values). A marked reduction in the carbon dioxide combining capacity of the blood plasma during severe acetonemia was not observed.

The data that we have thus far accumulated indicate that the qualitative test for "acetone bodies" in the urine is applicable only to the detection of these substances in the urine and gives little indication as to the presence or absence of "acetonemia." These data also indicate that cows under the conditions of this experiment may have abnormal amounts of "acetone bodies" in the urine but normal amounts in the blood.

P9. Certain Points in the Physiological Processes of the Cow. R. B. BECKER, Florida Agricultural Experiment Station.

A. The Omasum as a Grinding Organ. The fineness of feed particles in the several compartments of the cow's digestive system has been determined, using six Jersey and Guernsey cows on sole diets of corn silage, No. 2 alfalfa hay, alfalfa meal and Bermuda grass pasture. After slaughter, the contents of each organ were sampled, dried at low temperature, and separated by sieves into the sizes of particles, which were weighed.

Even a 16-year-old cow ground corn silage finely. Feed particles mainly exceeded 5 mm. in diameter in the 1st and 2nd stomach compartments, while 51 to 69 per cent by weight was under 1 mm. in diameter in the 3rd com-

partment (omasum) and beyond. The same was true of a second mature cow fed corn silage.

With No. 2 alfalfa hay (uncut), 64 to 75 per cent of the material in the third compartment and beyond, was less than 1 mm. in diameter, while anteriorly to this compartment, 57 to 69 per cent exceeded this size.

When No. 2 alfalfa hay was passed through a hammer mill to the point that only 1.09 per cent exceeded 1 mm. in diameter, it appeared that either the coarser portions delayed in passage, or the ground material swelled, and did not shrink on drying. This observation was after a 22-day preliminary feeding period with one cow.

One cow received Bermuda grass on pasture for 10 days prior to slaughter. Few feed particles in the 1st and 2nd stomach compartments exceeded 3 mm. in diameter. From the 3rd compartment onward, less than 6 per cent of the particles exceeded 1 mm. in diameter.

The third compartment of the stomach of each cow was severed into an anterior and posterior portion prior to taking the samples. In 5 out of 6 cases, the increased weight of small particles in the posterior portion suggested actual trituration or grinding in this organ. Little difference was seen in the sixth case.

This work, done between January and November in 1929, agrees with the conclusions of Trautmann and Schmitt in 1935. They short-circuited the omasum surgically in young goats, and found that feed particles were much coarser in the abomasums of operated goats than in normal animals of the same age. The 3rd compartment of the ruminant stomach is a grinding organ, and contributes to mechanical digestion of roughages.

B. Flow of Venous Blood from the Udder. Reference books state, and have been quoted, that venous blood leaves the udder through three pairs of efferent veins: the anterior, middle and posterior mammary veins, more commonly called subcutaneous abdominal, external pudic and internal pudic veins. These include Sisson's "Anatomy of domestic animals," Grimmer's "Lehrbuch der Chemie und Physiologie," Monvoisin's "Le Lait, physiologie, analyse, utilisation," and Missouri station bulletin 344 which cited Glattli.

On the other hand, Fuerstenberg, Plumb, Bitting, and Ernst, Mohler and Eichhorn (Textbook of milk hygiene) mention only two pairs of efferent veins from the udder. Sven Wall of Sweden showed the same in an illustration borrowed from the French veterinary text by Moussu in 1902.

In 1920, a group of graduate students under Prof. A. C. McCandlish failed to demonstrate three pairs of efferent veins in the udder taken from a heifer. Contrary to the text, valves were found in the internal pudic vein which would prevent outflow from the udder. Curiosity was aroused which discussion and reading did not satisfy.

Since 1923, 10 udders have been dissected at the Kansas, Oklahoma and Florida stations. Seven of these observed closely showed flow in the internal

pudic vein to be *into* the mammary venous plexus, rather than *away* from it. This means that the posterior mammary, or internal pudic, vein can no longer be regarded as an efferent vein draining the udder.

Other observations are that sometimes there may be a double anastamosis of the mammary veins in the rear of the udder. A variable number of valves occur in the mammary venous plexus which divide the direction of venous flow between the subcutaneous abdominal veins anteriorly, and the external pudic or middle mammary veins, upward from the rear quarters of the udder.

P10. The Adrenal Cortical Hormone in Relation to Lactation.* E. T. GOMEZ AND C. W. TURNER, Dairy Husbandry Dept., Missouri Agricultural Station.

Hypophysectomy of lactating laboratory and domestic mammals is followed by a rapid cessation of lactation. The injection of the purified preparation of the lactogenic hormone, galactin, immediately after hypophysectomy or after the complete cessation of lactation following the operation was found to be incapable of reinitiating or preventing the rapid cessation of lactation, the animals being dry in 2 to 3 days after the complete removal of the pituitary gland. However, when crude pituitary extracts were employed, milk secretion corresponding to that observed in normal lactating animals was maintained. These observations were taken to indicate that certain other pituitary principles either directly or indirectly through the endocrine glands controlled by them, supplement the effects of the lactogenic hormone in stimulating the secretion of milk. Experiments were, therefore, initiated in order to determine what other pituitary principles play a direct or indirect role in lactation. As it is well established that the thyroid and the adrenal (cortex) glands atrophy following hypophysectomy, our attention was turned to the hormones of these glands. In this report, however, only the role of the adrenal cortex in lactation will be considered.

The spontaneous hypoglycemic coma which develops in hypophysectomized guinea-pigs was successfully controlled to a great extent by the daily administration of glucose solution. In the experiments to be described it should be recognized that this solution played an important role in maintaining the level of blood glucose which is an important precursor of milk.

The injection of adrenal cortical extracts (eschatin) or the purified pituitary adrenotropic hormone which influences the activity of the adrenal cortex immediately after hypophysectomy of lactating guinea-pigs were incapable of supporting the continuance of the secretion of milk. However, when galactin was injected simultaneously with either eschatin or the adrenotropic hormone, the rapid cessation of milk secretion which follow hypo-

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 511.

physectomy was prevented and by continued treatment, lactation corresponding to that observed in normal parturient guinea-pigs was maintained.

These observations are believed to indicate that the reason for the cessation of lactation following hypophysectomy in the guinea-pig is due to the withdrawal of the lactogenic, the adrenotropic and probably the carbohydrate metabolism hormone of the pituitary. The adrenotropic hormone stimulates the production of a hormone or hormones by the adrenal cortex which in turn influences the salt and fluid metabolism. In adrenal insufficiency induced by hypophysectomy there occurs a rapid shifting of fluids and salts (NaCl) from the tissue and intercell spaces into the blood stream. The resulting polyurea after hypophysectomy and the associated increased excretion of salt causes a gradual withdrawal of fluid and consequently a dehydration of the tissues. As a result the passage of the precursors of milk from the blood stream to the mammary tissue is prevented, thereby depressing the secretary function of the lobule cells.

P11. The Rôle of the Nervous System in the Hormonal Control of Lactation.* R. P. Reece and C. W. Turner, Missouri Agricultural Experiment Station.

The influence of the nervous system on the functional control of the mammary gland appears to be a neglected field of physiological research. In the early investigations of Roehrig, where he sectioned the nerves leading to the udder, it is difficult to determine whether he was studying the influence of the nerves on milk secretion or on milk removal. If the nerves leading to the udder play any part in the control of mammary activity it is probably by their regulation of the vascular system. More recently, Selye *et el.* have shown that the act of suckling prevented the involution of the mammary gland of the rat during a period of 14 days, even though the milk ducts were ligated.

With the development of a technique for the determination of minute quantities of galactin in the pituitaries of laboratory animals it became of interest to determine the influence of suckling upon the galactin content of the pituitary gland.

Rats were allowed to nurse their young for 36 hours after delivery. The young were then removed for a period of 12 hours, receiving no nourishment during this period, and then returned to their mothers for a three hour nursing period. The mother rats were then sacrificed, their pituitaries removed and assayed. For controls the same procedure was employed except that the litters were not returned to their mothers. The pituitary glands from the suckled rats contained about one-third as much galactin as those from unsuckled rats.

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 512.

The question then arose as to whether the decrease in the galactin content of the rat pituitary under the influence of suckling was due to the stimulus of suckling or to the removal of milk from the mammary glands. By ligating the milk duct of each mammary gland in a series of lactating rats and then subjecting them to a nursing period of three hours it was possible to definitely decrease the galactin content of the pituitary glands.

P12. The Effects of Thyroxine on Milk and Fat Production.* H. A. HERMAN, W. R. GRAHAM AND C. W. TURNER, Dairy Husbandry Department, Missouri Agricultural Experiment Station.

It has been previously demonstrated that the injection of thyroxine in cows in the declining phase of lactation will increase milk secretion.

In view of these findings which are confined to only a few observations, it was decided to investigate this problem further, particularly because of its striking significance in the endocrine control of milk secretion. Cows in the various stages of lactation were selected for this project so as to demonstrate the effects of thyroxine on cows at the peak of their production, in the early declining phase, and also at the approximate end of lactation. Inasmuch as thyroxine raises the metabolism level, feed consumption has been carefully checked and the weight of the cows obtained weekly.

The project is divided into two phases: (a) the feeding of desiccated thyroid at levels of 2 ounces daily, and (b) the injection of thyroxine daily in doses of 5 to 10 mg.

In the thyroxine feeding 6 cows at the peak or just past the peak of production were used. Two cows at the peak of production showed little response in the way of an increase in milk and fat production, but for 9 weeks maintained a consistently high level of production (about 50–55 pounds daily) and immediately dropped to an average of 42 pounds per day when the thyroxine feeding was discontinued. Four cows just past the peak of production showed increases in daily milk production of 16 to 30 per cent. The production declined rapidly when thyroid feeding was discontinued for a 4 weeks period. Resumption of feeding, however, demonstrated a rapid rise in daily production even though most of the cows were in the 25th to 30th week of lactation. In one case the increase amounted to 344.5 per cent, but averaged approximately 20 per cent for all animals in the group.

The injection of 5 mg. thyroxine daily in four cows was noted to give increases in daily milk production of approximately 15 per cent when the cows were just past the peak of production. After three weeks, injection was discontinued, and then resumed after the cows had been in lactation from 160 to 180 days. In the second period of injection 10 mg. of thyroxine was being injected daily. This phase of the experiment is not complete but

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 514.

during the first week of injection, increases of 10 to 20 per cent in daily milk production, with a marked rise in fat percentage, was evident.

The percentage of fat in the milk produced was increased by both thyroid feeding and thyroxine injection. The solids-not-fat are apparently slightly increased during the periods of injection or feeding.

Three cows injected with thyroxine (10 mg. daily for 2 weeks) at the peak of their production have shown a rapid decline in daily production.

There was no marked change in the weight of the cows during the phases of thyroid feeding or thyroxine injection completed thus far.

P13. On the Carbohydrate and Nitrogen Metabolism of the Mammary Gland. W. R. GRAHAM, Dairy Husbandry Department, Missouri Agricultural Experiment Station.

Studies of the arterial venous differences for levels of constituents in the bloods of lactating goats together with blood volume flow measurements indicated that our knowledge of the nature of the precursors of milk is incomplete.

Experimental results are presented to show that the carbohydrate milk precursor fraction must be enlarged to include lactic acid and carbohydrate formed from protein decomposition. The respiratory quotients of the mammary gland indicate fat formation from carbohydrate.

The values for urea nitrogen found in the bloods show that the nature of the precursors of milk protein must be revised. The loss of nitrogen as urea by the mammary gland often exceeds the uptake of amino N as indicated by the same samples of blood.

The production of urea nitrogen by the mammary gland suggests a new avenue of thought regarding the possible mechanisms of the stimulation of milk secretion by high protein feeding.

P14. The Value of Corn Sugar in the Grain Mixture of Dairy Calves. CLIFTON A. WARD, C. Y. CANNON AND D. L. ESPE, Iowa State College.

Three groups of calves were fed from 10 days to 6 months of age. Group I was fed a standard grain mixture, while Groups II and III received a similar ration except that corn sugar replaced 10 and 20 per cent respectively of the grain mixture. The nutritive ratio of the grain mixtures fed the calves in Groups II and III was held constant by replacing a necessary amount of the corn with corn gluten meal.

Each of the three groups of calves made excellent gains. At 6 months of age the calves fed the 20 per cent corn sugar grain mixture were 24 pounds heavier, and two centimeters higher at withers than the calves in the check group, but when the data were treated statistically there were no significant differences in weight or in body measurement.

The corn sugar apparently increased the palatability of the grain mixture as the calves in Groups II and III started eating the grain earlier than the calves in Group I. The calves fed the 20 per cent corn sugar ration also consumed slightly more grain during the earlier part of the experiment when the grain was fed ad libitum.

P15. Replacing Whole Milk in the Calf Ration. R. T. PARKHURST, National Oil Products Company, Harrison, New Jersey.

Results of investigations reported before this Association by the U. S. Bureau of Dairy Industry and investigators in several experiment stations have shown that good results have been obtained by never letting the calf suck the dam and, after three days on colostrum, replacing the whole milk in the calf ration with only skimmilk, grain, hay, and a Vitamin A supplement.

On the basis of previous experimental work, the following method to replace whole milk and the sucking of the dam by the calf, has been recommended. The colostrum is fed in a bucket for four days. From the fifth day, one teaspoonful of vitamin A and D concentrate in cod liver oil (concentrated cod liver oil, fortified cod liver oil, cod liver oil fortified in vitamin A and D) is added daily per calf to separated or reconstituted skimmilk made by adding one part of dry skimmilk to nine parts of warm water. At three weeks, and until milk feeding is discontinued, the vitamin supplement is added at the rate of two teaspoonfuls per calf per day. As soon as the calf begins eating grain, calf meal containing the vitamin concentrate is kept in front of the calf at all times. Otherwise, three teaspoonfuls of the vitamin-carrying oil is fed per day.

Extensive field demonstrations covering a wide variety of conditions have shown that under field conditions it is often possible to successfully replace whole milk in the calf ration.

P16. Hay Consumption of Holstein Calves. H. S. WILLARD, University of Wyoming.

The Wyoming Experiment Station has become interested in investigating the factors influencing the consumption of roughage by dairy calves. The need of data became evident when a review of literature revealed a wide variation in the amount of roughage reported as consumed.

One group of eight registered Holstein heifer calves, hereafter called Group 1, were fed according to the average of the Morrison feeding standard. The calves were fed in individual box stalls from birth to 12 months of age. Whole milk was fed until the calves were about 3 months of age during which interval the grain mixture was fed ad libitum. Thereafter the grain allowance depended upon the consumption of hay but never got below 2 pounds daily. The calves were never allowed to go on pasture but had

access to a dry lot for about 5 hours during the day. Daily weights were taken on all calves. The hay and grain were weighed out to the calves daily and all refused feeds weighed back.

The grain mixture consisted of 3 parts ground barley, 2 parts ground oats, and 1 part wheat bran. One per cent common salt was added to this mixture. Long alfalfa hay was fed as a sole roughage. For the most part the alfalfa was of high quality ranging between 16 to 18 per cent crude protein. Oat and wheat straw was used for bedding. The calves had access to water in the dry lot and to drinking cups in the barn.

Another group of 8 registered Holstein heifer calves, hereafter known as Group 2, were fed in a manner similar to those in Group 1 until they were about 8 months of age. At that time the grain allowance was gradually decreased and the hay allowance increased until the calves were on hay alone at an average age of 10 months.

From birth to 6 months of age Group 1 consumed 34 pounds more hay, 95 pounds more grain but 188 pounds less milk per calf than Group 2. From 6 to 12 months age Group 1 consumed 248 pounds less hay and 149 pounds more grain per calf than Group 2. For the first 6 months between 10 to 12 per cent of the hay allowance was refused in both groups. During the second 6 months Group 1 refused 12 per cent and Group 2, 6 per cent of the hay offered. Even with a greater amount of hay fed to Group 2 there was a smaller percentage refused which indicated that the grain fed to Group 1 had a depressing effect on the hay consumption. Considering the hay and grain consumption of all 16 calves individually there was a trend toward greater hay consumption with a decreasing allowance of grain. The average daily hay consumption for Groups 1 and 2 when the calves were 8, 10 and 12 months of age was as follows:

	Age in months		
	8	10	12
	Average daily hay consumption (pounds)		
Group 1	8.7	11.6	13.1
Group 2	9.0	13.2	18.8

The rate of growth of both groups of calves was very similar and compared favorably with the average of experiment station data published in the 20th edition of Morrison's Feeds and Feeding.

The experiment shows the possibility of securing satisfactory growth by feeding calves on alfalfa hay alone beginning at 10 months of age.

P17. Development of Calves on Prairie Hay When Fed Milk from Dams on Similar Rations. H. W. CAVE, W. H. RIDDELL AND J. S. HUGHES, Kansas Agricultural Experiment Station.

From a prairie hay investigation there were available two groups of cows which had received only prairie hay and a concentrate mixture low in caro-

tene after six months of age. A third group fed the same except for the addition of Atlas sorgo silage was also available. It seemed desirable to further measure the nutritive value of prairie hay with calves from cows fed the same hay, a low carotene grain mixture and whole milk and skimmilk from their mothers.

Eight calves divided into two groups of four each were used in this trial, and were fed through a six months period. They were the first calves from the cows mentioned above. All of the dams of calves in Group I and two of Group II calves received prairie hay only as the roughage. Two of the Group II calves were from dams receiving silage in addition to prairie hay. The grain mixture fed all the dams consisted of equal parts of white corn chop, wheat bran and cottonseed meal.

All the calves received prairie hay ad libitum and a grain mixture consisting of equal parts of white corn chop and wheat bran, The hay fed to the dams and also to these calves were graded approximately No. 2 upland prairie. The grain allowance per calf at no time exceeded three pounds daily. For three days after birth each calf was fed its mother's milk. Thereafter, until two weeks of age, each calf in Group I received ten pounds of mixed milk from cows receiving only prairie hay as roughness. After the second week these calves were gradually changed to skimmilk separated from the milk of the same group of cows. Group II was handled in the same manner except that the whole milk and the skimmilk fed came from cows receiving a roughage ration consisting of prairie hay and Atlas sorgo silage. Calves in both groups were limited to twelve pounds of skimmilk daily.

The amounts of nutrients consumed by Groups I and II were approximately the same. For the purpose of another investigation these calves were the result of mixing breeds, a purebred Ayrshire bull mated to high grade Holstein cows. This mixture of breeds obviated direct comparison of growth with the standard growth curves. The average gain in body weight from birth to six months of age was 226 pounds in Group I and 232 pounds in Group II. In height at withers, the average gain per calf in the respective groups was 22 and 23 cms. These gains approximate the normal made by purebred Ayrshires in the Kansas State College herd and are probably somewhat below the gains which would be expected from calves of an Ayrshire-Holstein cross. In general, however, the calves appeared thrifty and reacted normally in all respects. Only one calf had digestive trouble and that was of short duration.

Although carotene determinations on the hay used indicated that the calves were receiving sufficient vitamin A, at the end of the trial they were tested for night blindness. There was no evidence of any defect in their sight. Calcium, phosphorus and hemoglobin determinations on the blood made at monthly intervals showed no significant variations from the normal.

P18. Limited Prairie Hay Rations and Avitaminosis in Dairy Heifers.
A. H. KUHLMAN, ANDREW NALBANDOV AND EARL WEAVER, Oklahoma A. & M. College.

During the past ten years more than fifty grade Jersey calves have been raised on a basal ration of milk, prairie hay, and cottonseed meal. In no single instance have any apparent symptoms of vitamin A deficiency manifested themselves, even when low grade prairie hay produced during drouth seasons was fed. In a preliminary phase of a study to determine the vitamin A requirements of dairy cattle for growth, manitenance, reproduction, and lactation, two groups of calves and heifers were fed limited amounts of prairie hay. The average amounts of prairie hay consumed by about forty heifer calves fed prairie hay ad libitum during the first year and of thirty-four heifers during the first gestation period were used as the bases for determining the level of hay intake. One group of calves and heifers was fed one-half as much hay daily as was consumed by animals of the full-fed roughage ration at corresponding ages, while the other group received one-fourth as much prairie hay. Each animal was fed an amount of cottonseed meal sufficient to supply the protein required at the given age for normal growth according to the Morrison Standard. Dried beet pulp and molasses beet pulp were fed in such amounts as were necessary to make the intake of total digestible nutrients equivalent to the Morrison Standard.

To date seven heifer calves have received the 50% hay ration and six the 25% hay ration for periods ranging from six to twelve months. All of these are the progeny of cows which have been fed a ration of prairie hay and cottonseed meal ad libitum and confined in dry lot for years.

Four calves in each group were started on the limited hay rations at birth. The remaining animals received a full prairie hay and cottonseed meal ration for periods ranging from two to nine months after birth. Gains in weight and general development have been equally good and very satisfactory in both lots, when a full hay ration was fed during the first 60–100 days or longer. Symptoms of vitamin A deficiency as indicated by running at the nose, coughing, and blindness have manifested themselves in several instances among the calves started on the limited hay rations at birth.

Four heifers raised on the standard prairie hay ration were also used in this study. At breeding age, two of them were changed to the 50% hay ration and two to the 25% hay ration. During the gestation period all four heifers made exceptionally good gains in weight and were in fact consistently above normal in condition, thriftiness, and weight.

Heifer No. 324 on the average consumed, 6.1 pounds of prairie hay daily, made a total gain in weight of 266 pounds in a 261-day gestation period. Her calf was born before term, weighed forty-one pounds at birth and lived only two days. Eyes of calf were normal. Placental membranes were retained. Heifer had scours several days before calving, and continued to scour after calving. She was weak and slobbered excessively. On the third

day after calving she had a violent convulsion and died within a few minutes. Post-mortem examination revealed a severe case of enteritis.

Heifer No. 331 in a 280-day gestation period on the average consumed 6.4 pounds of prairie hay and made a total gain of 280 pounds. Her heifer calf which weighed 55 pounds, was dead when found.

Heifer No. 338 in a 270-day gestation period on the average consumed 3.7 pounds of prairie hay daily and made a gain of 337 pounds. Parturition was entirely normal. Her heifer calf weighed 57 pounds at birth, and has always been strong and thrifty. After parturition No. 338 has been listless, dull, and refuses to eat well.

Heifer No. 504 in a 272-day gestation period on the average consumed 3.0 pounds of prairie hay and made a gain of 340 pounds in weight. Her bull calf weighed 52 pounds at birth, but was very weak and died in 30 minutes.

After calving, each of the three remaining heifers have been continued on the same ration fed during the gestation period. One hundred and twenty days after freshening, No. 331 produced 21 pounds of milk daily; forty days after calving No.338 produced 15 pounds of milk daily; and fifty days after calving No.504 produced 20 pounds daily.

P19. Limited Grain Feeding of Dairy Cattle. C. E. Wylie and L. R. Neel, University of Tennessee.

This experiment was started in February 1933 and is still in progress at the middle Tennessee Experiment Station, Columbia, Tennessee. There are two groups, of seven cows each, of registered Jerseys which are fed rations as follows:

Group I. (Full grain)
Alfalfa hay, ad libitum
Corn silage, 3 lbs. per 100 lbs. liveweight
Concentrates, 1 lb. to 3 lbs. milk
Pasture*, April to October inclusive

Group II. (Half Grain)
Alfalfa hay ad libitum
Corn silage, 3 lbs. per 100 lbs. liveweight
Concentrates, 1 lb. to 6 lbs. milk
Pasture* winter and summer (weather permitting)

Tables I and II show the results for four years:

TABLE I
Feed consumed per cow per year
Four Year Average for Seven Cows

GROUP	RATION	CONCENTRATES	HAY	SILAGE	PASTURE
			lbs.	*lbs.*	*days*
I	Full Grain	1836.1	3348.9	4983.7	298.5
II	Half Grain	974.8	2794.4	4328.5	346.0

* Pasture included bluegrass, lespedeza, and sudan grass in midsummer. The remainder of the year it included barley and rye in addition to bluegrass.

TABLE II

Production per cow per year

Four Year Average for Seven Cows

GROUP	RATION	MILK	BUTTERFAT
		lbs.	*lbs.*
I	Full Grain	6442.9	376.78
II	Half Grain	6265.5	367.96

P20. Some Experiences in Feeding Cattle on Rations Devoid of Roughage. T. W. GULLICKSON, Division of Dairy Husbandry, University of Minnesota.

During the past 15 years many animals have been used in experiments at this station to determine the cause of failure of cattle to thrive on rations devoid of roughage. This report presents data from a few individuals and groups from this large number. These animals were selected because they indicate the effect of feeding such rations under a variety of conditions and also the factor or factors that appear to have been lacking in such a diet.

Holstein calves, kept indoors and fed a normal ration except for a very limited intake of poor quality prairie hay to about six months of age after which only concentrates and a very limited amount of beet pulp was fed, developed vitamin D deficiency symptoms within a few weeks after the removal of the hay from the ration. This included very low blood calcium (as low as 4.39 mgm. per cent), convulsions or attacks of fits and slight stiffness. One animal died during a convulsive attack—blood calcium 4.98 mgm. per cent. Addition of calcium to diet resulted in only temporary and very slight relief, providing viosterol in the diet or exposing the animal to direct sunshine resulted in apparently complete but only temporary restoration to normal. Complete and permanent recovery was attained by feeding cod liver oil or good quality hay.

A Holstein heifer, about 18 months old, was taken from a rickets-producing diet and fed, after breeding, on concentrates plus 1.0 lb. of fair quality alfalfa hay. She was kept indoors. She remained nearly normal in appearance and in blood picture until within about 8 weeks of date of parturition, when swellings began to appear about the body and legs and finally she aborted approximately 50 days before full term. Soon after this the alfalfa hay was discontinued and $CaCO_3$ added, but her condition continued to grow worse. Feeding viosterol also failed to bring improvement, but with the addition of cod liver oil, improvement was rapid. She was bred again followed by normal parturition. Following this her condition indicated lack of some essential factor and was not relieved by supplying additional minerals and cod liver oil. Milk production was rather limited due to periodic fluctuation in appetite. Reproduction again was normal after

she was transferred to normal ration—with greatly increased production over previous lactation.

An aged (10 years) lactating Holstein cow from normal herd ration was placed on diet devoid of all roughage but including some beet pulp. The concentrates mixture included 40 per cent yellow corn. It was designed to be deficient in vitamin D. She was kept indoors. After two months her appetite began to wane, rear hocks became swollen, and later the forelegs and brisket. Addition of $CaCO_3$ was without effect. Feeding viosterol and exposing her to direct sunshine was not entirely effective in restoring her to normal, but either cod liver oil or hay proved to be effective.

From the foregoing and other data it appears that there are several essential nutritional factors deficient or entirely lacking in a ration of concentrates alone for dairy cattle. When such a ration is fed either one or a combination of several of these factors may become apparent, the one first to come into evidence seems to depend on the kind of ration previously fed to the animal, the age of the animal, and the character of the concentrates fed. Some other factor provided in hay, not identified but suggested by the data, appears to be required for high milk production by cows.

P21. A Comparison of Pasture Returns from Actual Grazing and Clip Plot Methods. I. R. Jones, H. P. Ewalt and J. R. Haag, Oregon State Agricultural College.

During the 1935 pasture season, there was available for study a 15-acre irrigated Ladino clover and grass pasture. The area was divided into three 5-acre pastures for rotational grazing. The pasture season extended from April 30 to October 1, a period of 154 days.

The 15-acre area was pastured by approximately 39 cows daily for a total of 5,999 cow days or by about 2.6 cows per acre for the season. The average daily production on pasture was 27.00 pounds of 4.86% milk or 30.483 pounds of 4% milk. The average initial weight of the cows taken on the 7th, 8th, and 9th days after pasturing began, was 902 pounds. The average final weight was 1005 pounds, representing an average gain in weight of 103 pounds during the 154-day period.

The average daily supplementary feed consisted of 4.05 pounds of a grain mixture and ¾ pound of oats and vetch hay, equivalent to 3.1 pounds of total digestible nutrients.

The total digestible nutrient requirement per cow has been calculated two ways using the latest Morrison tables. In the first case, a maintenance requirement based on the initial and final weights has been added to the milk requirement. In the second case, maintenance has been calculated on the initial weight and 4.3 pounds of total digestible nutrients for each

pound gain in weight has been added to the requirement for milk production.

Using the first method, the average daily requirement was 17.1 pounds of total digestible nutrients and with the second method 20.8 pounds. Subtracting the 3.1 pounds of nutrients fed in the barn gives respectively 14.0 and 17.7 pounds total digestible nutrients obtained from the pasture per cow. For the 5,999 cow days, the first method gives 83,986 pounds and the second method 106,182 pounds of total digestible nutrients as the returns for the 15 acres for the season.

During the pasture season the herd was rotated from one field to another a total of 18 times. Field 1 was provided with 8 sets of portable gates to protect 14×14 foot areas and fields 2 and 3 each with 4 sets of similar gates. A 10×10 foot plot from each protected area, was clipped at the end of each pasture period. The areas were clipped with a sickle about one inch above the ground. For the season, clippings were obtained on 96 plots representing 9,600 square feet. The green weight of the clippings totaled 2,289 pounds. The samples were dried and analyzed individually. More than half of the samples showed 18% to 22% dry matter. During the season there was obtained a total of 30.29 pounds of dry matter per 100 square feet or 13,194 pounds per acre. The 15-acre field might thus be expected to have produced 197,910 pounds of dry matter.

No digestion trials have been reported for Ladino clover and grass pasture. If we assume a digestion coefficient of 72% for the dry matter, the 15 acres produced 142,495 pounds of total digestible nutrients. Assuming 60% as the digestibility of the dry matter, the pasture produced 118,746 pounds of total digestible nutrients.

It can be seen from the figures given that results obtained by the clip plot method are considerably higher than the actual returns from pasturing with cattle even when assuming a low digestibility for the pasture herbage and allowing the factor of 4.3 pounds of total digestible nutrients for each pound gain in body weight. It should be pointed out that cows consuming this pasture walked an average of 4 miles daily going to and from pasture for which no allowance has been made in the above calculations.

It would appear that cows will actually utilize only some 75% of luxurious pasture herbage as measured by the clip plot method outlined above.

P22. The Losses of Dry Matter in Corn Silage Stored in Snow-fence Silos and the Cost Per Ton of Storage. J. B. SHEPHERD, Bureau of Dairy Industry, U. S. Department of Agriculture.

Three temporary snow-fence silos 4 sections high and 15 to 15½ feet in diameter were filled with corn silage on October 6 to 9, 1936. Silos 1 and 3 were lined with special silo paper. Silo number 2 was left unlined. The silos were filled with 32 to 35 tons of well-eared corn having 33.59 per cent

to 36.53 per cent dry matter. Leaves and stalks were about 50 per cent green, and the corn averaged 36 parts carotene per million parts of dry matter. Silo number 1 was opened and the silage fed after 32 days' storage, silo number 2 after 54 days' storage, and silo number 3 after 65 days' storage.

The silage settled more in the unlined silo than in the lined silos. The depth of spoilage on top was no greater for the unlined silo than for the lined silos. However, in the unlined silo the silage spoiled to a depth of 10 to 14 inches on the sides. This spoilage occurred from top to bottom of the silo. There was very little spoilage on the sides in the lined silos. The dry matter content of the good silage was 57.59 per cent of the total dry matter of the material ensiled in the unlined silo, as compared with 89.88 per cent in silo number 1 and 85.71 per cent in silo number 3.

Maximum temperatures attained at the top just below the spoiled silage were 149° F. on the 54th day in the unlined silo, 117° on the 32nd day in silo 1, and 122° on the 48th day in silo 3. Most of the silage in the unlined silo was dark brown to light in color, indicating considerable heating throughout the silo. The carotene content of the good silage removed was only 3.17 parts per million of dry matter for the unlined silo compared with 17.72 for silo 1 and 12.85 for silo 3. Chemical analyses indicated little difference in the chemical changes taking place in the good silage in the different silos. The losses were apparently moderate and confined principally to crude fiber and nitrogen free extract.

Six medium producing cows were fed the corn silage as the sole roughage, with sufficient grain to provide a little excess of nutrients. The good silage from the three silos was consumed at about the same rate. The average consumption of dry matter in the form of silage was 23.75 pounds per head daily. In feeding period immediately following, these same six cows consumed an average of 20.34 pounds dry matter daily in the form of corn silage from an ordinary concrete silo; the latter silage was higher in moisture and acidity than the former. Milk production was equally well maintained, with a low rate of decline, on the silage rations from the four silos.

The materials used in one lined silo consisted of four 50-foot sections of snow fencing, seven lengths of No. 9 galvanized wire (about 25 pounds), seven turnbuckles, and one and one-third rolls of special silo paper (666 square feet per roll). Based on average corn containing 70 to 71 per cent moisture, each snow-fence silo had a storage capacity for 40 tons of green corn.

At the prices paid in 1936, the materials for one lined silo cost $29.26 or a total of $30.72 including one year's interest on the investment at 5 per cent. If used only one year, the cost of materials per ton of storage capacity would be $0.77. If all the materials except the paper lining are used for four years, and a new paper lining purchased each year, the annual depre-

ciation, plus 5 per cent interest on the average yearly investment amounts to $14.69 or $0.37 per ton capacity.

P23. The Apparent Digestibility and Feeding Value of Apple-Alfalfa Silage. J. C. KNOTT AND R. E. HODGSON, State College of Washington, and Bureau of Dairy Industry, U. S. D. A.

Silage was made from a combination of 80 per cent apples and 20 per cent alfalfa hay. Digestion experiments and feeding trials were conducted each year for two years. The silage was unusually palatable and in the feeding trials with heavy producing cows appeared to be somewhat more valuable for milk production than sunflower silage. The butterfat from the cows receiving apple-alfalfa silage was higher in carotene than the butterfat from cows receiving sunflower silage. The average apparent digestibility of the nutrients in apple-alfalfa silage for the two years was: crude protein 52 per cent; crude fiber 49 per cent; ether extract 47 per cent; and nitrogen-free extract 70 per cent.

The average composition of the apple-alfalfa silage on a dry matter basis was: dry matter 23.0 per cent; crude protein 9.7 per cent; crude fiber 30.9 per cent; ether extract 3.2 per cent; nitrogen-free extract 49.0 per cent; and ash 7.1 per cent. On these bases 100 pounds of the apple-alfalfa silage contained 1.2 pounds of digestible crude protein, and 13.2 pounds of total digestible nutrients.

P24. Mungbeam Silage for Milk Production. A. H. KUHLMAN, ANDREW NALBANDOV AND EARL WEAVER, Oklahoma A. & M. College.

On account of their ability to withstand prolonged periods of drouth and extremely hot weather and to thrive on rather thin upland soils, mungbeans have been grown quite extensively in many sections of Oklahoma as an emergency hay crop. The results of two feeding trials with milk cows indicate that mungbeans may have considerable merit as a silage crop under conditions which are not favorable for the production of crops usually grown for this purpose.

During the severe drouths of 1934 and 1936 when most crops were failures, golden mungbeans (*Phaseolus radiatus*) attained a height of two to two and one-half feet. Both crops were cut with a grass mower, run through a silage cutter, and ensiled in a small tile silo. In 1934 the mungbeans were quite mature at the time of cutting and had produced very few pods, but in 1936 many pods developed, only a small percentage of which were mature at the time of harvesting.

In both seasons a good quality of silage was obtained. The silage packed much more firmly than either corn or sorghum silage. It did not have the strong odor usually associated with legume silage and was very palatable. Nothing was added to the beans at the time of cutting to aid in preserving them.

In two double reversal feeding trials in which mungbeans silage replaced one-half of the alfalfa hay fed in the check ration, the results indicate that approximately 260 pounds of mungbeans silage replaced 100 pounds of No. 1 alfalfa hay. In both trials there was no significant different in the milk yields of the two rations fed.

The use of mungbeans as a silage crop eliminates the rather large losses due to difficulty often encountered in producing hay of high quality resulting from the shattering of leaves while curing and the development of mold. The considerable waste which occurs in feeding mungbean hay due to the refusal of cattle to eat the coarser stems is also eliminated in mungbean silage.

P25. Molasses Grass Silage as the Sole Roughage Diet for Milk Production and Growth of Dairy Animals. C. B. BENDER, J. W. BARTLETT, H. H. TUCKER AND J. MIXNER, New Jersey Agricultural Experiment Station.

In order to evaluate molasses grass silage as a roughage for milk production, 12 Holstein cows were chosen at the North Branch of the New Jersey Agricultural Experiment Station and were divided into 4 groups of cows each. The animals in each group were balanced according to age, stage of lactation and daily production in preliminary milking period. The groups received as their sole roughage, grass silage alone, grass silage and dehydrated hay, grass silage and corn silage, and corn silage and dehydrated hay. Each group was fed the particular roughage for a 3 week period. A one week transition period was then allowed the animals in the groups in changing to the next roughage. All groups were milked and fed twice a day.

The milk production and body weight reactions by all groups for the 4 feeding periods according to the roughage fed is shown in the following table.

	GRASS SILAGE AND HAY	CORN SILAGE AND HAY	GRASS SILAGE	GRASS SILAGE AND CORN SILAGE
Total milk	9283.9	9183	9081	8869
Ave. daily prod.	36.84	36.44	36.04	35.20
Weight changes by groups	+297	−66	−114	−61

Discussion. While this experiment was in progress it was found to be impossible to maintain the intake of grass silage alone and grass silage and corn silage at the calculated intake levels. This no doubt may have had some effect on the productive level and without a doubt it did effect the weights of the animals. From the appearance of the animals it was impossible to determine which feeding group they represented.

From the results obtained in this particular experiment it is concluded that molasses grass silage will replace corn silage or hay in the ration of a

dairy cow without influencing the productive level of the cows to a marked extent. When fed in place of both corn silage and hay the productive level was maintained although there was a slight loss in body weight in the animals in this group. There is no doubt that a change in the grain ration could have overcome the slight loss in body weight manifested by the straight grass silage group.

To determine the growth response of Holstein and Guernsey heifers to a sole ration of either molasses grass silage or molasses grass silage and dehydrated hay, two groups of yearlings and bred heifers were fed during the winters of 1935–36 and 1936–37.

In the molasses grass silage group 20 Holsteins and 22 Guernseys of various ages were used. In the molases grass silage and hay groups 18 Holsteins and 22 Guernseys made up the experimental group. All animals were over 10 months of age and no animals were included which freshened during the feeding trial.

Timothy molasses silage was used in this experiment and the hay was dehydrated mixed hay. The silage averaged 68.0 per cent moisture and 2.7 per cent protein. The hay averaged 12.5 per cent moisture and 11.6 per cent protein. The animals fed grass silage alone were allowed to consume all they could eat. Their average consumption was 46.3 pounds per day. The other group was limited to 31 pounds of grass silage and 6 pounds of dehydrated hay to meet their requirements of dry matter according to Henry and Morrison's standards for growing heifers.

The average gains for the two feeding periods of 110 days each are given in the following table:

Molasses grass silage

	WEIGHT PER DAY	HEIGHT 110 DAYS	HEART GIRTH 110 DAYS
Holsteins	.75 Lbs.	5.3 cms.	5.6 cms.
Guernseys	.58 "	4.7 "	5.1 "

Grass silage and hay

Holsteins	.97 Lbs.	5.6 cms.	7.4 cms.
Guernseys	.70 "	5.1 "	6.2 "

Discussion. On the straight timothy silage ration the quality of the timothy as influenced by maturity and the moisture content effected the consumption by the animals. The intake varied between 38.5 pounds daily and 52 pounds. This factor of quality must be given serious consideration if maximum weight gains are to be made. The animals in both groups appeared thrifty and it was impossible to differentiate between the groups.

The condition of the bowels was excellent excepting at the start of the experiment.

Athough the weight gains may be considered subnormal the height gains were above normal when compared to Ragsdale's standards. The molasses grass silage and hay animals made better average weight gains and slightly better gains in height and heart girth. This, no doubt, was caused by the increase in nutrients consumed by this group. With grass silage at $4.60 per ton compared to $7.04 for corn silage, it makes an extremely inexpensive as well as nutritious feed.

P26. Relation of Grass Silage to the Color, Vitamin C and Flavor in Milk from Individual Cows. O. F. GARRETT, C. B. BENDER AND H. H. TUCKER, New Jersey Agricultural Experiment Station.

Molasses grass silage made from mixed grasses was fed to 4 groups of 3 Holstein cows each and to 4 groups of 4 Guernsey cows each from December 1, 1936, to April 12, 1937. The following roughages were fed to the various groups of Holsteins and Guernseys: grass silage, grass silage and dehydrated hay, grass silage and corn silage and corn silage and dehydrated hay. The grass silage and hay was made from grasses which would average 60% timothy, 25% clover and 15% alfalfa. The grasses were ensiled with 70 to 75% moisture; 50 pounds of molasses were added per green ton.

The Holstein cows were used in a reversal experiment of 3 weeks each with 1 week transition period. The groups of Guernsey cows were not changed from their original feed throughout the 19 weeks. The Holstein groups receiving grass silage as the sole roughage or in part showed a slight advantage in both color and flavor over the group receiving no grass silage. The periods were of such short duration, however, that any one feeding period would be materially affected by previous feeds fed to these animals.

Individual samples from single milkings were taken at weekly intervals and were immediately analyzed for fat and yellow color. Each sample was divided into three parts the last two of which were stored in glass bottles in a refrigerator at about 40° F. The first part of each sample was analyzed for vitamin C and immediately thereafter scored for flavor. The second and the third parts were removed from storage on the two succeeding days respectively and were also analyzed for vitamin C and checked for flavor score.

It is concluded from the data studied that:

In the Guernsey groups the color was maintained more uniformly in the groups receiving grass silage as part or all of their roughage.

The roughage ration which contains a high proportion of good quality molasses grass silage is superior to corn silage in its ability to produce milk of high color and flavor.

A significant correlation coefficient of over 0.6 based on data from all the cows indicates a definite reationship between vitamin C and flavor of milk from individual cows. When the vitamin C content is high the flavor of the milk usually will be good.

The yellow color in milk from individual cows bears a relation to the flavor of that milk as indicated by correlation coefficients of over 0.4 and over 0.6 for Guernseys and Holsteins respectively.

A very definite relationship exists between vitamin C and yellow color in milk from individual cows of both the Guernsey and Holstein breeds as indicated by correlation coefficients of over 0.5 and over 0.6 respectively.

The percentage of fat in milk from individual cows has little or no significant relationship to the flavor of that milk according to an analysis of the results on all the samples studied.

P27. Technique Used in Studying Vitamin A Requirements of Dairy Cattle. L. A. Moore, Michigan State College.

Some inconsistency seems to exist between different experiment stations on symptoms produced in vitamin A deficiency. At the Michigan Station xerophthalmia has not occurred. Night blindness has not been noticed except where calves went blind due to a constriction of the optic nerve.

With such variations occurring a more desirable method of detecting and following vitamin A deficiency was sought. Two advances have been made. The first consists of following the level of blood carotene. The method consists essentially of precipitation of the proteins in the plasma by alcohol and extraction of the yellow color with petroleum ether which is then read in a Lovibond Tintometer. It has been found that below certain levels reproductive troubles and symptoms of vitamin A deficiency occur.

The second advance consists of following the condition of the nerve head of the eye by the use of an ophthalmoscope. In vitamin A deficiency papillary edema and clouding of the disc occur. By following these two guides vitamin A deficiency can be diagnosed long before the health of the animals is so injured that they fail to recover properly.

In studying vitamin A requirements the animals are placed on a vitamin A free ration till the blood carotene has been reduced to a certain level and papillary edema occurs. Carotene is then added to the ration to bring the blood carotene up to a certain level, which should theoretically maintain the animal or prevent reproductive troubles. The work has been limited to animals of the Holstein breed.

P28. The Carotene and Color Content of Home-grown Roughage Feeds and the Relation of These Rations to the Carotene, Color and Vitamin A Activity of the Butterfat. R. E. Hodgson, J. C.

KNOTT, H. K. MURER AND R. R. GRAVES, Bureau of Dairy Industry, U. S. D. A., and State College of Washington.

The color of the field cured grass and clover hay used in the experiments indicated in general the carotene content of the hay and the color of the butterfat produced by cows fed exclusively on this hay. Over a three-year period the average carotene content of rations of home-grown hay, grass silage, hay and silage and pasture were 15, 57, 197 and 259 micrograms per gram of dry matter, respectively. When fed to Holstein cows they produced butterfat with average carotene content of 3.6, 6.5, 6.8 and 7.9 micrograms per gram. There was a close relationship between the color and carotene content of butterfat.

The ration of home-grown field cured hay apparently furnished enough of the vitamin A factor for normal body activities, reproduction and the production of butterfat of approximately 50 U.S.P. units per gram. The hay and silage ration produced a butterfat containing 86 units per gram, the grass silage 97 units per gram and the pasture 105 units per gram.

The cows receiving the hay ration secreted on the average of 0.72 per cent of the ingested carotene in the butterfat; those receiving hay and silage, 0.23 per cent and those receiving silage alone, 0.14 per cent.

The carotene content of the butterfat was a very good index of its vitamin A value. The vitamin A activity in the butterfats attributable to the carotene apparently was 11.2 per cent for the hay ration, 12.7 per cent for the hay and silage ration, 11.3 per cent for silage ration and 13.7 per cent for the pasture ration.

P29. Effect of Carotene Intake on the Carotene and Vitamin A Content of Butter.* H. J. SMITH AND E. B. POWELL, Ralston Purina Mills.

Fifteen Guernsey cows were divided into three experimental lots and were fed over a ten month period at three different levels of Carotene intake. The Carotene intakes were determined by frequent spectrophometric analyses of Carotene extracts of both the grain and roughage parts of the ration. At regular intervals samples of butter from each lot were analyzed spectrophometrically for Carotene and biologically for vitamin A.

The average results of the test were as follows:

CAROTENE INTAKE (MILLIGRAMS PER COW PER DAY)	CAROTENE CONTENT OF BUTTER (MILLIGRAMS PER KILOGRAMS OF FAT)	VITAMIN A INTERNATIONAL UNITS PER KILOGRAM
110	1.95	8000
307	3.48	11000
381	5.27	13500

P30. An Attempt to Remove the Vitamin A Suppressing Factor in Soybean Oil by Adsorbents. S. M. HAUGE, J. W. WILBUR AND J. H. HILTON, Purdue University Agricultural Experiment Station.

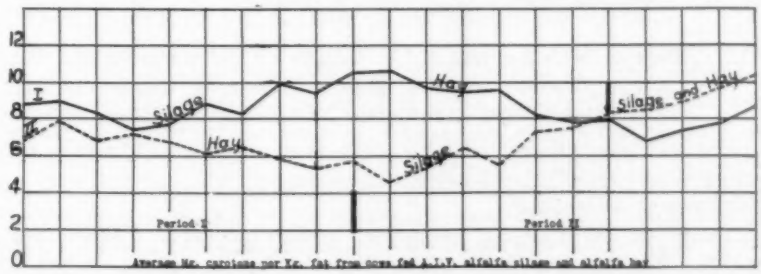
Experiments at the Purdue Station have shown that soybeans, when fed in rations to dairy cows, interfere with the transference of the vitamin A potency of the ration to the milk fat secreted by the cows. A recent series of experiments has shown this factor to be associated with both the soybean oil meal and soybean oil produced either by the expeller or solvent processes. The factor seemed to be highly concentrated in the oil and some preliminary studies have been conducted in an attempt to remove it from the soybean oil. A sample of crude soybean oil was treated with activated carbon and another sample of oil treated with a synthetic sodium aluminum silicate. These treated oils were then fed to dairy cows and studies made of their effect on the carotene content and vitamin A activity of the milk fat secreted by cows.

The results of this preliminary trial would indicate that activated carbon removed a good portion of the vitamin A suppressing factor in soybean oil, while the other adsorbent was without effect.

P31. The Relation of A.I.V. Alfalfa Silage and Carotene Content of Milk. W. E. PETERSEN, J. B. FITCH AND N. N. ALLEN, University of Minnesota.

Alfalfa hay and A.I.V. alfalfa silage put up from the same field simultaneously under farm conditions were secured. The silage was pronounced excellent and the hay graded U.S. No. 1.

Two groups of 6 cows each were used. Group I was fed silage in period I and hay in period II. Group II was fed hay during period I and silage



Average Mg. carotene per Kg. fat from cows fed A.I.V. alfalfa silage and alfalfa hay

in period II. The roughage was limited to hay or silage in the respective periods with the hay limited to approximate the dry matter furnished in the silage. The remainder of the nutrient requirements were furnished in grain.

Samples of milk were taken and the carotene content in the fat determined colorimetrically every 2 to 3 days. The results are presented graphically for the groups. It is to be noted that the carotene declined when hay

Mg. carotene per kg. fat when fed A.I.V. silage and hay

COW	BREED	BEGINNING	END OF PERIOD I		END OF PERIOD II	
A7	Gr. Holstein	4.00	5.04		3.81	
421	Holstein	4.09	6.06	A.I.V. Silage	4.24	
440	Holstein	3.64	5.01		5.68	Hay
445	Holstein	3.92	4.42		2.94	
548	Guernsey	16.00	17.91		16.50	
580	Guernsey	10.71	17.92		12.08	
A6	Gr. Holstein	4.88	3.62		6.85	
217	Jersey	9.36	5.40		8.96	
419	Holstein	6.08	4.32	Hay	7.42	A.I.V. Silage
423	Holstein	3.71	2.78		2.98	
539	Guernsey	16.80	10.98		19.56	
442	Holstein	5.70	3.92		5.86	

was fed and increased when the silage was fed. The decline in carotene content of the fat when hay is fed is due to the necessary reduction in amounts of hay to approximate the dry matter in the silage. Prior to the experiment the cows were fed liberal quantities of green colored alfalfa hay.

Difficulty was experienced in getting the cows to consume enough silage. Approximately twice as much dry matter would readily be consumed in the hay as in the silage.

Milk production also declined more rapidly in the silage periods than in the hay periods. Group II was allowed both hay and silage *ad libitum* for 10 days following the close of the experiment when the carotene content of the fat rose markedly.

Marked individual variations were noted in the increases of carotene in the fat. These are presented in the following table:

P32. Effect of Molasses and A.I.V. Silages on the Carotene and Vitamin A Content and the Growth-Promoting Quality of Milk.

D. M. HEGSTED AND G. BOHSTEDT,* University of Wisconsin.

The molasses and acid (A.I.V.) methods of ensiling alfalfa have been compared and the effect of feeding such silages on certain properties of the milk has been determined.

Thirty ton lots of alfalfa were put up by each method in 1935 and again in 1936. The first year the green alfalfa had a low dry matter content (22 per cent) and the second year a much higher figure (30 per cent). Blackstrap molasses was applied to the forage at the rate of 100 lbs. per ton in 1935 and 65 lbs. in 1936.

Judged by acidity (pH) ammonia content, the silages were well preserved by both methods. In all four lots the pH value was under 4, and the

* In collaboration with C. A. Elvehjem, E. B. Hart and W. H. Peterson, of the Agricultural Chemistry Department, and I. W. Rupel, of the Animal Husbandry Department.

percentage of the total nitrogen present as ammonia nitrogen averaged slightly under 10 per cent for the molasses silage and about 5 per cent for the A.I.V. Apparent carotene ranged from 100–200 mg. per kilo but was considerably higher in the A.I.V. silage. No great reliance can be placed on these figures because acid, either applied or developed increases the apparent carotene of forage and silage.

Feeding trials over a period of three months during 1935–36 and again in 1936–37 the animals maintained their weight and produced about the same quantity of milk. Check rations containing alfalfa hay and adjusted to the same nutritive ratio and energy intake gave equally good results.

In 1935–36 carotene and vitamin A determinations were made on the butterfat at the end of the experimental period. No significant differences were obtained among the three groups. Carotene figures for the check, molasses, and A.I.V. groups in order were 6.5, 7.4, 7.6 micrograms per gram and vitamin A 9.0, 10.0, 11.0. Data on the 1936–37 experiment are not complete but preliminary results indicate approximately the same carotene and vitamin A values for the three groups.

Each year milk from the groups was mineralized and fed to rats to determine its growth promoting quality. The differences obtained were very slight and the milk was uniformly good from all the groups both years.

P33. Oxidized Milk Flavor as Related to Carotene, Lecithin and Vitamin C. C. H. Whitnah, W. H. Martin and G. H. Beck, Kansas Agricultural Experiment Station.

Some investigators have reported that the occurrence of oxidized flavor in milk may be associated with such normal constituents of milk as carotene, lecithin and vitamin C. This investigation was initiated to determine the relationship between these constituents and oxidized flavor of milk.

Samples of morning milk from the four breeds of dairy cows in the college herd (60–70 head) were collected in glass bottles on three consecutive days during the months of December to April inclusive. The cows were fed various winter rations but they were not on pasture during the trial. The milk was examined while fresh and again after three days storage at 45° F. for the presence of off flavors, and tested chemically for vitamin C. The amounts of lecithin in the milk were determined by testing samples taken at various intervals, and the amounts of carotene were estimated from color determinations made on the milk fats. The oxidized flavor was detected in 12.7 per cent of the 922 samples examined during the regular monthly herd test.

Records were kept of rancid flavors and other off flavors which may have been due to feed or to storage conditions. No certain relation was found between any of these off flavors and the development of a flavor which could be definitely characterized as oxidized.

Some investigators have been able to prevent oxidized flavor by the addition of vitamin C to the milk. In this study only the vitamin C naturally occurring in the milk was considered. The rank of the breeds according to average vitamin C content of milk was: Jersey, Guernsey, Ayrshire, Holstein. The frequency with which oxidized flavor developed was in the reverse order. Within the breed, however, there was no relation between the amount of vitamin C and the development of oxidized flavor in milk from individual cows.

From results obtained in this experiment milk of low lecithin content developed oxidized flavor just as readily as milk of high lecithin content.

All samples which developed oxidized flavor were below the breed average in intensity of fat color. There were, however, samples low in color which did not develop oxidized flavor. It has been previously shown that the oxidized flavor of milk could be improved by the addition of carrots and dehydrated alfalfa to the ration. It was decided to increase the amount of carotene in the ration fed to selected groups of cows producing badly oxidized milk. Three cows were fed dehydrated young oat plants at the rate of two pounds per head daily. A carotene concentrate soluble in fat solvents prepared by "Nutritional Research Associates, Inc.," of South Whitley, Indiana, was fed to one cow at the rate of four pounds daily, and to two other cows at the rate of one pound per head daily. The oats contained 103 mg. and the carotene concentrate 150 mg. of carotene per pound. Oxidized flavor was never entirely eliminated by feeding dehydrated oats, but the flavor was greatly improved. The flavor defect was entirely eliminated in two to four days by feeding the concentrate. One pound of concentrate seemed to be as efficient as four pounds in improving the off flavor. The color of the fat was not increased for some time after the flavor was improved.

P34. The Vitamin D Requirement (U.S.P. Units) for Growth and Well-Being of Calves from Birth to Six Months of Age. S. I. Bechdel, Neal W. Hilston and N. B. Guerrant, The Pennsylvania State College.

The main object of the study reported herein was to establish definite data on the U.S.P. unit requirement of vitamin D for growth and well-being of calves from birth to six months of age.

Thirty-three grade Holsteins were used as experimental subjects. They were kept in a darkened stable and confined in individual box stalls. Wood shavings were used for bedding.

The basal ration was made up largely of the following concentrate mixture:

50 parts old yellow corn
20 parts gluten meal
20 parts ground oats
7½ parts soybean oil meal
2 parts precipitated chalk
½ part common salt

Whole milk was fed for the first four weeks on experiment. Dry skim milk was then included in the ration until the calves were past four months of age. Domestic dried sugar beet pulp was used as the sole roughage.

A commercial preparation of carotene was fed (average 7500 U.S.P. units of vitamin A) daily to each calf to insure an adequate supply of vitamin A.

All feeds and vitamin carriers were carefully assayed for vitamin D. Activated yeast and cod liver oil concentrate were fed to different groups at levels ranging from 100 to 500 vitamin D units per 100 pounds live weight per calf per day. A balling gun was used in administering these vitamin supplements.

Weekly determinations of the inorganic blood phosphorus and calcium were made. X-ray photographs of the distal end of the left ulna were taken every two weeks.

Rickets in a mild to severe form appeared in the control animals at four to five months of experiment. The data to date indicate quite clearly that the average minimum requirement is 300 U.S.P. units per day per 100 pounds live weight from birth to six months of age. Cod liver oil concentrate and activated yeast were equally effective in the prevention of rickets. The data justify the conclusion that the units of vitamin D from activated yeast and cod liver oil concentrate are equally effective in preventing the onset of rickets in calves.

P35. Studies on Methods of Concentrating the Vitamin D of Butterfat for Assay Purposes. G. C. WALLIS, Dairy Dept., South Dakota State College.

The method of concentrating the vitamin D of butterfat for assay purposes as outlined by Bechtel and Hoppert (Jour. of Nutrition 11: 537–549) was being used in connection with some of our research work. Difficulties were observed which seemed to indicate that all of the vitamin D in the butterfat was not being recovered in the concentrate. It was found upon further study of this point that only about 50–75 per cent of the vitamin D of the butterfat was being recovered. Some variations of the method were tried but without any notable success in recovering all of the vitamin D. These experiences have been reported as a caution to other workers who might be attempting to concentrate the vitamin D of butterfat to facilitate the assaying of relatively impotent samples.

P36. X-Ray Technique for Studying Rickets in Calves. S. I. BECHDEL AND NEAL W. HILSTON, The Pennsylvania State College, AND ROBERT F. LIGHT, Fleischmann Laboratories, New York.

In a study of rickets in calves covering the period from birth to six months of age x-ray photographs of the distal end of the left ulna were taken every fourteen days. A general Electric, Model F, portable set was used. A 5×7 film was used and the tube was set uniformly at thirty inches from the cassette. Exposure ranged between one-half to three-fourth second. The epiphyseal line at the distal end of the ulna was observed to be quite wide in all calves at ten days of age. The control animals which developed rickets tended to maintain the original wide line throughout the experiment.

The calves that were given vitamin D supplements in proper amount displayed a rapidly closing epiphyseal line. This observation was in very close accord with inorganic blood calcium and phosphorus data. The equipment and technique described herein is recommended as being highly satisfactory in studying calcification of bones in living calves. It gives promise of being a relatively quick and inexpensive method.

P37. Effects of a Vitamin D Deficiency on Mature Dairy Cows. G. C. WALLIS, Dairy Dept., South Dakota State College.

This is a progress report of an experiment in which mature dairy cows have been subjected to vitamin D deficient conditions by keeping them indoors at all times and using a ration consisting of 15 pounds of molasses beet pulp for roughage with a grain mixture of corn, oats, and corn gluten meal to balance the ration. A bone meal supplement has been used to insure an adequate supply of calcium and phosphorus for normal conditions and additional vitamin A was provided by a special concentrate.

The vitamin D deficiency manifested itsef in several ways. Cows producing liberally showed a decline in the total calcium and inorganic phosphorus of the blood plasma. In severe cases the calcium would decline to one-half or two-thirds of the normal level and the inorganic phosphorus to about one-fourth of the normal. Balance trials run while the animals were deficient in vitamin D showed that marked losses of calcium and phosphorus were being sustained. As the deficiency progressed the animals developed a typical rachitic stiffness and enlargement of the joints with bending of the knees and humping of the back. It became very difficult for the animals to walk, get up, lie down, or turn around. Some loss of appetite was usually exhibited.

Upon the administration of vitamin D, as viosterol, with no other change in the ration, the level of blood calcium and inorganic phosphorus showed a noticeable improvement in three days and was usually back to normal in about two weeks. The negative mineral balances were converted into large

retentions, as for example, about one-half pound of calcium and one-fourth pound of phosphorus in a ten-day trial. The appetite would improve and the stiffness and swelling would begin to disappear in a week or ten days leaving the animal seemingly normal in this respect in a month or so.

The fact that such decided manifestations of a vitamin D deficiency have been exhibited by mature animals lends considerable significance to these observations. Preliminary studies on several other phases of this interesting problem have already been made.

P38. Irradiation of Milk; the Interrelation of Radiation Intensity and Milk Film Capacity. H. H. Beck, H. C. Jackson and K. G. Weckel, University of Wisconsin.

Observations made in connection with studies covering the irradiation of milk showed that there is an optimum response by milk to activation by ultra violet radiation under a particular set of conditions, and this led to the study of the effect of varying the conditions over a wide range. A rectangular stainless steel surface $36'' \times 36''$ and a quartz mercury vapor arc centered on each milk film were employed for the studies. The line test procedure was used to determine the antirachitic potency of the milk.

It was found that for any film capacity from 90 to 1350 lbs./hr./ft. optimum response by the milk was uniformly obtained when the mercury vapor arc was 6″ from the milk. This distance for optimum response was found to prevail for any active radiation intensity between 1000 and 7000 mw./cm.^{2} on the milk film.

The vitamin D potency of milk varies as a parabolic function of the total applied active radiant energy from an arc source at any fixed distance from the milk film. This relation was found to prevail when either the film capacity or radiation intensity were varied. For example, the increase in potency obtained by reducing film capacity by one-half is exactly equivalent to that obtained when doubling the intensity of the radiation of the milk.

Extension of these studies to the carbon arc have provided preliminary results which indicate that the distance for optimum response by the milk to these powerful arcs is between 4 and 12 inches.

P39. Hair Pigment. W. E. Petersen and W. M. Sandstrom, University of Minnesota.

When very thinly sectioned or finely ground black bovine hair is examined microscopically the pigment granules appear red. Only when these pigment granules are closely packed do they present a black appearance. To secure more information as to whether or not the pigment particles of different colored bovine hair are the same, the pigment was isolated from hair and dispersed in various amounts in a casein glue which was then drawn out to hair-like threads. By varying the concentration of the pigment (isolated from either red or black hair) in the casein glue, it was

possible to produce "artificial hair" varying in color from a light yellow to a black.

The diameter of the hair also influenced the color, the artificial hair of larger diameters being darker in color than those of fine texture.

Chemical analysis of the pigments from different colored hair are now being made.

P40. The Relation of the Endocrine Glands to the Inheritance of Milk Secretion.* C. W. TURNER, Dairy Husbandry Dept., Missouri Agricultural Experiment Station.

Breeders of dairy cattle constantly wonder why the daughters of a sire may vary so widely in their capacity to secrete milk. Some daughters may produce two or three times as much as others even when of about the same size and apparently of similar external conformation. In a study of this problem Eckles and Rood (1910) reported that the main difference between profitable and unprofitable dairy cows is not to be found in the coefficient of digestion or in the amount of food required for maintenance. The superior cow is simply one with a large capacity for using food above the maintenance requirement and one that uses this available food for milk production.

Since this classic work little progress has been made in further analyzing the physiological differences between low and high producing dairy cattle. There is a tendency to say that poor producing cows have inherited a low capacity for milk production, which is entirely true, but what has not been widely recognized is that the inheritance received has a definite physiological and anatomical basis. It is believed that the recent developments in the field of the endocrinology of milk secretion at least furnish the explanation of the physiological differences between cattle of low and high milk production.

Within the past few years, the evidence of the key importance of the pituitary gland in relation to the control and regulation of the other endocrine glands has increased enormously. It has been shown that the pituitary secretes hormones which stimulate the ovaries and testes, the growth and secretion of the mammary gland, the thyroid and parathyroid, the adrenals and possibly other glands. In addition the pituitary secretes hormones which influence milk secretion indirectly through their effect on the metabolism of carbohydrate, fat and protein which regulate the precursors of milk in the blood.

Studies have shown that individual hormones of the pituitary and the glands so stimulated have increased the milk production of individual cows from 10 to 50 per cent. These observations show that when hormonal deficiencies of dairy cattle are corrected these animals are capable of greatly

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 513.

increased milk production. While it may be found practicable and feasible (by the discovery of cheap sources of the hormones) to try to correct individual glandular deficiencies, the greatest importance of the discoveries in the endocrinology of milk secretion is in relation to the selection and breeding of better cattle, in other words, a new method of studying the inheritance of milk secretion.

In short the proposed method is to determine the endocrine deficiencies which are suppressing the milk production of individual cows; by (1) the determination of the increase in milk production when individual hormones are administered, by (2) the determination of the amount of the hormones in the blood during maximum lactation, or by (3) the rate of excretion of the hormones in the urine. In this way the several pituitary factors influencing directly and indirectly the growth and secretion of the udder would be determined. This information will explain for the first time exactly what in their constitution has made it possible for the high producing cow to transform large quantities of nutrients into milk and which endocrine deficiencies have limited the production of others.

With the ability to gain this information about the endocrine constitution of dairy cattle, a number of experiments of basic importance could be conducted. (1) Study the mode of inheritance of each gland complex by mating groups of cows low (or high) in any character with a sire who had produced daughters distinctly above (or below) their dams in this character. (2) Use this tool for the selection of cattle to continue as foundation animals in a herd. (3) To explain why the daughters of a sire in one herd may show great improvement and in another herd might be mediocre. (4) By the discovery of the chief deficiencies and excellences of the families of dairy cattle it should be possible to bring together those individuals which would supplement the deficiencies and thus combine characters which would result in the production of milk far above the present standards.

In the future, the endocrinologist will serve the dairy cattle geneticist in the same capacity as the chemist serves industry in the control of manufacturing processes.

P41. Evaluation of Different Measures of Inherited Producing Ability in Dairy Cattle.[1] GORDON E. DICKERSON, University of Wisconsin.

Many different types of production records have been used or proposed for use in measuring the relative inherited producing ability of dairy animals. Among the more important or widely used, are the C.T.A. yearly, the first 240 days, 305 days, and 365 days of lactation, and the total lactation production.

The data studied include the records of Holstein and Guernsey cows which were on D.H.I.A. test during at least their first five lactations. Cows

[1] Paper from the Department of Genetics, Agricultural Experiment Station, University of Wisconsin. No. 216. Published with the approval of the Director of the Station.

with records known to be abnormal were not used. Each cow's production was measured in terms of all five types of records mentioned. In all, there were 1574 of each type of lactation record, and 1434 C.T.A. yearly records, for 274 Holsteins in 41 different herds. For 59 Guernseys there were 340 lactation, and 299 C.T.A. yearly, records, in 11 different herds.

Correction factors were calculated for age at calving, calving interval and lactation length, short previous dry periods, season of calving, age at beginning of the C.T.A. year and days in milk during C.T.A.year. Correction for age, calving interval length, lactation length, and days in milk during C.T.A. year were based on the average within-cow regression.

Different methods of adjusting actual butterfat records were studied by analysis of variance, to determine the relative value of each as a measure of differences between cows in inherited producing ability.

A part of the results for Holsteins are summarized in the accompanying table.

Apparently any differences between cows in shape of lactation curve which appreciably affect lactation butterfat production were expressed in the first 240 days of lactation.

When the average interval between calvings is 13 months or more, little was gained by correcting production in the first 305 days of lactation for short calving intervals. Differences between herds were increased; those between cows in the same herd were reduced; while variation between records of the same cow was not changed.

Correcting for season of calving increased differences between records of the same cow nearly as much as the differences between cows.

The age-corrected production in the first 240 or 305 days of lactation measured differences in producing ability between cows in the same or in different herds with practically the same degree of accuracy as the first 365 day, or total lactation production, corrected for age and calving interval or lactation length. Correcting for short preceding dry periods (0–3 weeks) further increased differences between cows in the same or in different herds.

The C.T.A. yearly record, corrected for age, did not seem to measure differences between cows in the same herd as clearly as the corrected lactation records, when first year records shorter than 9 months, and later records shorter than 8 months are discarded. Using later records shorter than 8 months may increase the differences between cows. Adjustment to a standard number of days in milk did not change the percentage of the variance occurring between cows in the same and in different herds, even though the total varianse was reduced about one-eighth.

Dividing the age-corrected total lactation production by the interval between dry dates corrects for very short preceding dry periods. It also allows variation due to differences between cows in length of dry period and length of lactation to remain in the average daily production figure. Eleven per cent of the intra-herd variance in lactation length and 16 per

cent of that in dry period length was due to differences between cows. To the extent that these differences between cows are hereditary, differences between cows in average daily production due to length of previous dry period and lactation should not be removed, and the above method of correction is justified. This age-corrected average daily production in the interval between dry dates measured differences between cows in the same or in different herds as clearly as any other type of record. It has the added advantage of being a practical measure of relative efficiency of production.

The age-corrected average daily production in the interval between calvings does not correct for short previous dry periods. Only about 6 per cent of the intra-herd variance in calving interval length was due to differ-

Portion of variance due to differences between cows for various types of production records

TYPE OF RECORD	CORRECTED FOR	GROSS STD. DEV.	PER CENT OF TOTAL VARIANCE OCCURRING BETWEEN			PER CENT OF VARIANCE WITHIN HERDS OCCURRING BETWEEN COWS
			All cows	Cows in diff. herds	Cows in same herd	
1st 240 days of lactation	Uncorrected	73.5	33.1	15.8	17.3	20.5
	Age	69.6	44.6	19.9	24.7	30.8
	Age, dry pd.	70.5	46.6	20.7	25.9	32.7
	Age, dry pd., season	72.1	46.0	20.2	25.8	32.3
1st 305 days of lactation	Uncorrected	86.0	34.8	18.0	16.8	20.5
	Age	81.9	45.3	20.3	25.0	31.4
	Age, C. I.	81.5	45.4	21.3	24.1	30.7
1st 365 days of lactation	Uncorrected	94.7	36.0	16.5	19.5	23.4
	Age	91.8	42.9	17.6	25.3	30.7
	Age, C. I.	85.4	46.0	21.1	24.9	31.5
Total lactation	Uncorrected	105.9	33.0	12.2	20.8	23.7
	Age	105.2	37.7	13.7	24.0	27.8
	Age, length lact.	82.4	46.1	20.6	25.5	32.1
	Age, C. I.	86.3	46.2	21.4	24.8	31.6
	Age, C. I., dry pd.	88.0	49.7	22.3	27.5	35.2
Avg. prod. per day—calving interval	Age	0.24	44.6	23.2	21.4	27.9
Avg. prod. per day—pd. between dry dates	Age	0.23	50.3	25.0	25.3	33.8
C. T. A. yearly	Uncorrected	85.6	37.8	20.9	16.9	21.3
	Age	85.6	42.8	22.2	20.6	26.5
	Age, days in milk	80.3	42.6	22.1	20.5	26.3

ences between cows. This may explain why it did not measure differences between cows in the same herd as efficiently as did the age-corrected average daily production in the interval between dry dates.

The fact that each type of record was studied on the same population of cows should be considered in determining the significance of differences in results with the various types of records and methods of correction.

To the extent that cows with five or more successive lactations are superior to those leaving the herd earlier, this study may underestimate the proportion of the variance within herds which is due to differences between cows.

P42. Are Culls Really Culls. D. M. SEATH, Iowa State College.

A study was made of 60 herds in Iowa Cow Testing Associations as a step in determining the part that culling plays in the average herd's production. Each herd had tested for at least 3 consecutive years between 1930 and 1935. Mature equivalent milk and butterfat records were used as measures of a cow's producing ability.

For each of the four years studied the cows were divided into "culls" which were cows gone from the herd the following year and "non-culls" which were still in the herd the next year. Obviously, many of these "culls" left the herd because of disease, injury, old age, death, etc., and not because of low production. Regardless of why they left the herd they no longer influence its average or contribute sons or daughters to it.

The average butterfat production of the non-cull group exceeded that of the culls by 71, 52, 49, and 32 pounds for the four years studied, the average difference being 50 pounds. In milk production the average difference was 1194 pounds. These differences were all highly significant statistically. The intensity of culling varied from herd to herd to a small but significant amount.

The amount of culling varied significantly from year to year. For the four years 25, 27, 29, and 32 per cent of the cows left the herds. The 32 per cent was in 1934, a drought year, when an abnormal reduction in cattle numbers took place. This year, with the highest percentage culled, showed the least spread in production between the culls and non-culls.

P43. Differences between Records, Real Productivity, and Breeding Values of Dairy Cows. JAY L. LUSH AND FLOYD ARNOLD, Iowa State College.

Data used in proving 103 sires by comparing the lifetime averages of 676 daughters and dams in Iowa Cow Testing Associations were studied to find what share of the differences between single records were really due to permanent differences between the individual cows and what share of those permanent differences were transmitted to the daughters.

The cows mated to each sire were divided into a high half and a low half according to the amount of fat each produced in the first lactation she was tested. Then the later records of the same cows were averaged. Then the records of the daughters of the high group of dams and of the low group of dams were averaged separately. The results in pounds of fat were as shown in table at top of p. 443.

The regression which the later records show from the first records toward the herd average shows the extent to which differences in the first records were caused by temporary circumstances. The repeatability of single records or the fraction of the variance in the single records which was caused by permanent individual differences between cows was 43 per cent in these data.

	HIGH DAMS	LOW DAMS	DIFFERENCE
Average of the records (the first one for each cow) on which the division was made	440.4	338.3	102.1
Average of later records of the same cow	*407.3*	*364.2*	*43.6*
Regression toward herd average	−32.6	+25.9	57%
Average of all records of the daughters	393.4	379.3	14.1

The difference between the average records of the two groups of daughters, when doubled and divided by the average difference between the first records of their dams, measures the degree to which variations in single records are inherited and could be gained in the first generation of selection. In these data 28 per cent of the variance in single records was thus inherited. Only 15 per cent was from permanent characteristics of the cows either not hereditary at all or due to effects which the genes have in certain combinations but not in others (*i.e.*, from permanent effects of environment on the cow herself, from dominance deviations, and from epistatic deviations, all three of these sources of variation lumped together).

By far the most important cause of discrepancy between the record of a cow and her breeding value is thus the temporary environmental circumstances which may be widely different, even in the next lactation. The most effective ways for making selections and progeny tests more accurate are the use of lifetime averages and whatever can be done to standardize environmental conditions or to correct for any unusual conditions which are known to have existed.

Since equal numbers of daughters from high and from low dams were studied for each sire, differences between herds were cancelled from these data. The question of whether those herd differences are due to differences in the average heredity of the cows or to management and other environmental conditions is interesting and is important practically but is not answered here. These findings describe intra-herd differences only.

MANUFACTURING SECTION

M1. The Isolation of the Citric Acid Fermenting Streptococci from Butter Cultures. H. C. Olson, Iowa State College.

Tomato agar modified by the addition of small amounts of alpha bromopropionic acid just before pouring is very useful as a plating medium for the isolation of the citric acid fermenting streptococci from butter cultures and other materials. The citric acid fermenting streptococci grow well in the presence of amounts of the acid that inhibit *Streptococcus lactis*. The concentrations of the acid required to inhibit *S. lactis* vary with the different lots of tomato agar used, but usually range from 0.2 to 0.6 ml. of N/10 solution per 100 ml. of agar. Bromoacetic acid is less useful than alpha bromopropionic acid because the range over which it is effective is so sharply limited. Other alpha bromo aliphatic acids did not give selective inhibition.

M2. The Correlation between the Organisms Found Microscopically in Butter Serum and the Grade of Cream from Which the Butter Was Made. Theodore Hedrick, Montana State College.

Five hundred and twenty-five samples of butter were studied by the microscopic method to determine the correlation between the microorganisms in butter and the grade of cream from which it was churned. Of the 143 samples of butter churned from cream scoring 93 or above, 91.6 per cent were correctly graded. Of the 126 samples churned from cream scoring 91½ to 92½, 59.4 per cent were accurately determined. Of the 159 samples from cream scoring 90 to 91 per cent, 43.4 per cent were correctly graded, and of the 97 samples churned from cream scoring below 90, 53.6 per cent were accurately graded. Different holding periods, 1 to 30 days, for the butter at 2° to 4.5° C. (36 to 40° F.), did not influence the accuracy of the determination of grades of cream from which it was made.

M3. The Detection of Mastitis by the Brom-thymol-blue Test, Leucocyte Count, and the Microscopic Examination of Milk. A. C. Fay, H. W. Cave and F. W. Atkeson, Kansas Agricultural Experiment Station.

On a basis of routine examination of individual quarter samples of milk from cows in the Kansas State College herd, the animals have been segregated in the dairy barn into three principal groups as follows:

A class—those animals regarded as free from mastitis.
B class—animals regarded as suspicious for mastitis because of a high leucocyte count (500,000 or more per ml.) in the milk from one or more quarters.

C class—cows regarded as positive for mastitis because of the presence in the milk of long-chained streptococci and usually, though not necessarily, a high leucocyte count.

An analysis of nearly 7000 comparative tests leads to the following deductions:

1. The brom-thymol-blue test detected only 21.1 per cent of the samples taken from quarters known to be infected with mastitis.

2. On samples taken from cows diagnosed as free from mastitis, the brom-thymol-blue test gave false readings in only 1.6 per cent of the cases.

3. If a brom-thymol-blue test is positive, there is a 92.7 per cent chance that the cow will be found positive for mastitis on further examination.

4. If a brom-thymol-blue test is negative, there is a 55.2 per cent chance that the cow is actually negative, and hence a 44.8 per cent chance that the test is false.

The value of the brom-thymol-blue test may be summated by the statement that, although it rarely gives a false reaction with a known negative cow, it fails to detect a sufficiently high per cent of the positive cases to recommend it as a sole means of identification of mastitis for segregation purposes.

5. The fact that high leucocyte counts above the arbitrary standard of 500,000 per ml. were found in only 36.7 per cent of the samples actually containing long-chained streptococci suggests that this standard may be too high for proper interpretation.

6. Long-chained streptococci were detected in 85 per cent of replicate samples taken from quarters in which the organism had previously been found. The fact that the organism was not detected in 15 per cent of the samples from these known infected quarters emphasizes the necessity of repeated analyses for positive diagnosis.

7. Leucocyte counts above 100,000 per ml. and the appearance of streptococci in chains of only medium length were frequently found to give forewarning of impending mastitis.

8. Once an animal has been justifiably moved from A-class down to B- or C-class, there is little likelihood that it will be advisable to reclassify her again in A-class. Experience with this herd has shown that, with few exceptions, such reclassifications have been based on false hope.

9. Mastitis was found in this herd in 13 per cent of heifers in their first lactation period, 38 per cent of cows in their second lactation period, and increasingly higher percentages in later lactations.

M4. A Combined Pasteurizer, Cooler and Incubator for Mother Starter.

G. H. Wilster and F. E. Price, Oregon State Agricultural College.

A tank for pasteurizing and cooling jars of milk for mother starter, and a water-jacketed incubator for the inoculated milk in the jars were designed

and constructed in 1932 at the Oregon Agricultural Experiment Station. (See Bulletin 301: "Design of Equipment and Method for Preparing Starter for Oregon Creameries and Cheese Factories," by F. E. Price, G. H. Wilster and C. J. Hurd.)

This equipment has proven very satisfactory both in the Oregon State College Creamery and in commercial plants.

The tank for pasteurizing and cooling has now been equipped with an electric heater that is connected with a thermostat so that it is possible to maintain a temperature of the water in the tank of 70° to 72° F. during the incubation period. The jars of pasteurized milk, after cooling and inoculation, are placed in the water when the temperature of the water has been regulated to 70° F. The tank is not insulated but it may be found that, under certain conditions, insulation of the tank will be desirable.

The coagulated milk may be quickly cooled by first allowing cold water from the water system to replace the 70° F. water in the tank. Crushed ice is then added to the water to bring the temperature down to 32° F., or cold brine is allowed to flow through a coil that is submerged in the tank. After having been thoroughly cooled the jars of mother starter can be placed in the regular refrigerator. The tank is then ready for the next batch of milk.

With this tank an incubator for incubating the inoculated milk is unnecessary.

Tests show that with a room temperature ranging from 45° to 70° F. during the incubation period, the temperature of the water in the tank (not insulated) can be uniformly maintained at from 70° to 72° F.

M5. Studies upon a Bacteriophage Inhibitory to Streptococcus lactis. F. E. Nelson, University of Minnesota, and B. W. Hammer, Iowa State College.

In most of the bacteria-free filtrates obtained from typically "slow" butter cultures and from many of those obtained from cultures which coagulated normally an ultrafilterable principle which inhibited the growth of certain strains of *Streptococcus lactis* was demonstrated. Under the proper conditions, lysis of a sensitive culture in a liquid medium and the production of plaques on a solid medium could be shown. Propagation at the expense of sensitive cultures of bacteria was accomplished. Resistant strains of *S. lactis* were isolated from the secondary growth of a culture upon which the principle had acted. The extreme specificity of the principle was demonstrated, and the existence of a number of different strains was indicated. The effects of physical and chemical factors upon the principle were studied. The characteristics of the inhibitory principle indicate that it is a bacteriophage active against *S. lactis*.

M6. The Dye Concentration in Culture Media Employed for the Analyses of Escherichia-Aerobacter Members in Milk. H. D.

McAuliffe and A. A. Borland, Department of Dairy Husbandry, The Pennsylvania State College.

Recent work has indicated that one of the limiting factors in tests to determine the presence of *Escherichia-Aerobacter* members in milk has been the culture medium employed. In most instances the concentration of the bacteriostatic agents in these media were developed for use in water analysis. Assuming the possibility of these dyes being absorbed on the milk solids, leaving only a fraction of the original concentration of dye for inhibitory purposes, studies have been made to determine a more desirable dye concentration to be used in milk analysis.

Whole milk was added to lactose broth containing various dye concentrations (ratio: 1 part of milk to 10 parts of broth). This mixture was dialyzed through a semi-permeable membrane, and the amount of unadsorbed dye determined colorimetrically. Results with fuchsin lactose broth show that in order to have the recommended amount of dye available (1 part in 66,500) for bacteriostatic action in the presence of milk solids, the concentration of basic fuchsin should be increased seven times (to 1 part in 9,500). A concentration of 1 part basic fuchsin in 13,300 parts lactose broth was found non-inhibitive to a skim milk suspension of pure cultures of the *Escherichia-Aerobacter* group.

Similar investigations employing brilliant green lactose bile 2.0 per cent showed that the concentration of brilliant green in this medium should be increased two and one-half times, from 1 part in 75,000 to 1 part in 30,000. It is believed that lactose broth employing these higher concentrations of dyes offers a more selective means of detecting the *Escherichia-Aerobacter* organism in milk.

M7. The Effect of Salts on the Growth of Bacteria in Milk. C. S. Mudge and T. G. Anderson, University of California.

Traces of certain elements—Cu, Fe, I, Mn, and Zn—are known to be present in milk. In milk, too, organisms are found which seem to grow best in that environment. Attempts to grow such bacteria in a non-milk medium meet with but partial success. Addition of casein or of lactose aids these bacteria, to be sure, but this growth is less than that found in milk. However, our results reveal that when the salts of the elements mentioned above are added to peptone media, greatly increased growth is obtained.

M8. Comparative Studies on Bacterial Milk Counts in Various Types of Media Incubated at 20°, 30° and 37° C. J. Drexel Dennis and Harry H. Weiser, Ohio State University.

Other types of culture media and lower incubation temperatures, than

those recommended by Standard Methods, have been suggested by some investigators for enumerating the bacteria in milk.

The bacterial counts of 37 composite samples of raw milk produced under average farm conditions were determined on tryptone-glucose-skim milk agar (as proposed by Bowers and Hucker, 1935), nutrient agar plus 0.5 per cent skim milk, yeast extract agar (as suggested by Devereux), and standard nutrient agar. Each inoculated medium was incubated at 20°, 30° and 37° C. for 48 hours and the colonies counted under standardized conditions.

A comparison of the bacterial counts at 37° C. incubation showed that 30 of 37 milk samples gave higher counts per ml. on tryptone-glucose-skim milk agar, 20 on nutrient agar plus skim milk, and 16 on yeast extract agar than were obtained on the standard nutrient agar.

Using an incubation temperature of 30° C., 34 of the same specimens gave higher counts on tryptone-glucose-skim milk medium, 13 gave higher counts on skim milk agar, and 19 were higher on yeast extract agar than on the standard medium.

When incubation was at 20° C., a higher bacterial count than in the standard agar was obtained in 32 of the 37 samples cultured in tryptone-glucose-skim milk medium, in 17 specimens in agar plus 0.5 per cent skim milk, and in 14 milk samples tested in yeast extract agar.

It is apparent that tryptone-glucose-skim milk agar gave higher bacterial counts than any of the other media, when incubated at 30° C. At 20° C. all of the media showed an increase in the bacterial counts over standard agar but the differences were not as great as at an incubation temperature of 30° or 37° C.

Bacteria were transferred to individual tubes of litmus milk from all colonies on the highest dilution plates of all media, for the purpose of determining the variety of bacteria encouraged to grow by the constituents of the individual media. Judging by the greater diversity of reactions in the litmus milk tubes, the tryptone-glucose skim milk agar supported a larger variety of bacteria than any other medium, and this was more evident at 30° than at 20° or 37° C.

M9. A Study of Comparative Methods and Media Used in the Microbiological Examination of Creamery Butter—I. Yeast and Mold Counts. G. W. Shadwick, Jr., Director of Control Laboratory, Beatrice Creamery Company, Chicago, Illinois.

A study of comparative methods for determining the yeast and mold counts of salted and unsalted butter has been made using as culture media freshly prepared potato dextrose agar and dehydrated Difco potato dextrose, peptonized milk, malt, whey and wort agars. Representative data are presented and discussed. The necessity for better methods of determining the mold count particularly of unsalted butters is outlined.

M10. Proposed Standard for the Yeast and Mold Count of Salted Butter Made from Sour Cream. E. H. PARFITT, Purdue University.

A standard is suggested for the evaluation of effective pasteurization and for adequate production practices based on the yeast and mold count per ml. of the finished butter. The proposed standard is based upon the analysis of over 2,000 samples of salted butter made from sour cream, (1) as to the ability of the industry to attain these standards, (2) the attainment of these standards in plants under control, and (3) the influence of method of analysis of the butter on the numbers of yeasts and molds found.

The proposed standard is as follows: Less than 50 yeasts and molds per ml. of butter as representing good conditions of manufacture; 51 to 100 per ml. as representing fair conditions; 101 to 500 per ml. as representing poor conditions; and over 500 per ml. as representing very poor conditions of manufacture.

M11. Studies on Oospora lactis. H. MACY AND D. L. GIBSON, University of Minnesota.

Sixty-one cultures of *Oospora lactis* have been isolated from Canadian and domestic butter and preliminary observations made upon their morphological, cultural and biochemical characteristics. Distinct differences are noted in colony formation, both as to size and appearance, with remarkable variations on several media. The phenomenon of sectoring of colonies is striking, with certain strains showing persistency toward this physiological variation. The size of conidia fluctuates widely even in the same culture. Optimum growth temperatures range from 15° C.–25° C. with restricted growth of most strains at 10° C. certain cultures develop normally at 30° C. while others are practically dormant at such a temperature. Three cultures resist heating at 57° C. (135° F.) for 30 minutes, one at 60° C. (140° F.) for the same period but none surviving after exposure to 62.8° C. (145° F.) for one-half hour. Normal development of these cultures in all cases is disturbed at salt concentrations of 7.5 per cent or higher while only five show any sign of growth at 10 per cent. Growth is meagre at pH 3.0 or lower, generally best above pH 4.0, and luxuriant but somewhat atypical at pH 7.0 or higher. The upper limit of growth for all cultures has not been established definitely. All strains produce indol, liquefy gelatin to some extent, and show lipolysis of cottonseed oil and butterfat. None produce an acid reaction in litmus milk, or hydrolyze starch. Acid is formed in glucose broth in all cases, but gas only in nine instances. Maltose, lactose, sucrose, inulin and salicin are not attacked. Flavors produced in skimmilk, whole milk, cream and starter are not pronounced except by six cultures where fruity to cheesy flavors are evident. Further studies are to be made on

the significance of the varying characteristics of the apparently numerous strains of this species.

M12. Pseudomonas fragi and its Importance in Dairy Products. H. F. Long and B. W. Hammer, Iowa State College.

Pseudomonas fragi has been repeatedly isolated at the Iowa Agr. Exp. Sta. from various dairy products and is apparently widely distributed. It is psychrophilic and samples of raw milk and cream held at low temperatures frequently produce a characteristic odor suggesting the flower of the May apple (*Podophyllum peltatum*). Later the samples may be rancid. The species has never been isolated from pasteurized milk or cream directly from the vat but has been found frequently in bottled pasteurized milk and cream which indicates contamination after pasteurization. Occasionally, cottage cheese develops an off or "May apple" odor due to the growth of *Ps. fragi*. The organism is extremely variable making its characterization difficult; from plates poured with freshly isolated cultures smooth, intermediate and rough colonies may be obtained. These variants differ to a great extent in their ability to hydrolyze fat and protein. The most common reaction in litmus milk is a slight acidity, first noticeable at the surface, followed by coagulation, partial reduction and slight proteolysis; other strains, however, produce an alkaline reaction or do not visibly change the medium. Due to this variability the organism may be found in butter exhibiting a May apple odor, rancidity or cheesiness; it has been isolated repeatedly from both salted and unsalted butter obtained in Iowa and surrounding states.

M13. The Manufacture of Sweetened Condensed Whey and Its Use in Foods. G. A. Ramsdell and B. H. Webb, Dairy Research Laboratories, Bureau of Dairy Industry, U. S. Department of Agriculture.

The increasing possibilities for the use of whey in foods call for a whey product that will not spoil and that can be easily processed. It has been found that whey partially condensed and sweetened can be blended with certain other food products into a nutritious and palatable new series of foods.

The method of manufacture of this sweetened condensed product is simple and economically performed at the source of supply, that is, the cheese factory. Pasteurized whey is condensed to a total solid content of 75 per cent including the added sucrose which should be 28 pounds for every 400 pounds of whey. The sucrose is added preferably near the end of condencing. This finished product will contain approximately a 1 to 1 ratio of whey solids to sucrose, which is sufficient sucrose to preserve it. The product should be cooled to approximately 30° C. as soon as removed from

the pan and stirred quite vigorously while cooling, so as to produce fine lactose crystals. The procedure is similar to that used by the sweetened condensed milk industry in producing a smooth product. It has been found that while this product increases in viscosity slightly with aging at room temperature, even after four months it is still sufficiently fluid for use. The sweet whey is kept in air-tight containers to prevent mold growth.

Investigation has shown that sweetened condensed whey manufactured as above described can be used in preparing such foods as fruit whips, certain types of candy, and in some foods where it can be substituted for egg white. The material whips readily to a heavy stable foam and with the addition of suitable flavors and colors makes an excellent icing. It should also find a place at soda fountains as topping for hot chocolate and sundaes.

M14. The Manufacture of Non-Foaming Casein. G. A. Richardson, N. P. Tarassuk and L. B. Fry, University Farm, Davis, California.

This progress report is based on attempts to demonstrate to students the effect of method of manufacture on the foaming tendency of casein. It was found impossible to confirm all the recommendations made and the conclusions drawn in a recent paper (Ind. Eng. Chem. *25*, 1213, 1933).

The results of the investigation indicate that usual fluctuations in the temperature of precipitation and the degree of agitation during precipitation are not the determining factors in the foaming qualities of acid-precipitated caseins. Experiments also indicate that breed, and chronic mastitis exert only a very slight effect, if any, on the foam indices of casein manufactured from the milk. Analyses of 71 commercially manufactured caseins from 6 plants and 35 laboratory samples fail to show any consistent relationship between the fat content and the foaming index of casein unless the fat content is abnormally high. Blending of a low-foaming casein with a high-foaming casein results in a mixture of foaming tendency dependent largely upon the type of the low-foaming ingredient.

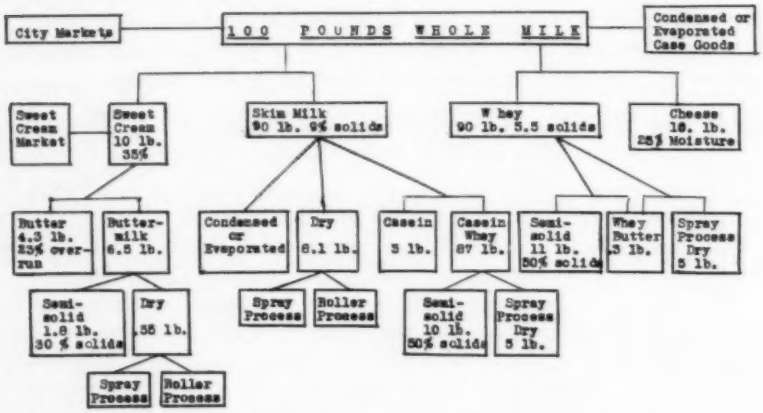
Non-foaming or at least low-foaming casein may be made from low foaming skimmilk, buttermilk, a mixture of skimmilk and buttermilk, or skimmilk of abnormally high fat content. To consistently manufacture a low-foaming casein from the general supply of skimmilk it appears necessary to add to the milk some foam inhibitor which is occluded or adsorbed by the casein and which is not removed during the working and drying operations. A foam inhibitor found to be satisfactory and economical is diglycol laurate.

M15. Flexible Milk Plants. W. E. Guest and R. W. Balderston, W. E. Guest and Company.

The natural evolution in rural creameries, located outside the city milk sheds, from cream centralizers to creameries taking in sweet cream has resulted in better quality butter and better prices to farmer producers. A

further evolution has come in the plant taking in whole milk and separating cream for market or butter, and making the skimmilk into various marketable products. The problem then becomes one of equipping the plant to make the various products, and also for management to obtain markets and make the products which will give the greatest net return for the liquid milk.

The attached charts show the various products which can be made in a flexible milk plant and show how different items of equipment are used in the different manufacturing processes.



In a flexible milk plant, manufacturing schedules can be changed on very short notice, making it possible to switch from casein production to dry milk powder as markets fluctuate, etc. Since variations in market prices of various milk products show little relationship to their cost of production or yield from a given quantity of whole milk, skillful management can materially increase the net return by adjusting manufacturing schedules to meet market conditions. The paper shows graphically the relationship, based on past markets, of the net return per 100 pounds of milk for these various products, and a basis for management to compute net returns in order to decide which product to make.

M16. Sonic Homogenization of Milk and Ice Cream Mixes. LESLIE A. CHAMBERS, Johnson Foundation for Medical Physics, University of Pennsylvania.

A general theory of the mechanism of emulsification by sound waves of great intensity has been developed. The dispersive action depends on the vigorous collapse of cavities at interfaces between the immiscible liquids. Cavitation will occur in the system wherever local displacement velocities reach a value such that the hydrodynamic pressure is less than the vapor pressure. This follows from Bernoullis law

$$P + \frac{\rho V^2}{2} = k$$

where P is the hydrodynamic pressure, ρ the density of the liquid, and V the velocity. In a heterogeneous system the disruption will normally occur at interfaces.

It can be shown that the number of disruptions and subsequent effective cavity collapses is directly dependent upon the rate of energy transfer (intensity), and upon the frequency of the sound wave.

Development of apparatus for the sonic homogenization of milk and ice cream mixes has progressed to such an extent that satisfactory results are now possible on a commercial scale. A summary of plant scale experiments indicates that the process is sufficiently effective and economical to justify the consideration of the industry at the present time, and points the way to future engineering development of more efficient apparatus through the employment of higher vibration frequencies.

M17. A Suggested Method of Evaluating Homogenization Efficiency by Improved Photomicrography. A. W. FARRALL AND R. L. HANSON, The Creamery Package Mfg. Company, Chicago, Ill.

A need exists for a standardized method of mathematically comparing the efficiency of homogenization. This is of particular value in the design of dairy equipment but should be of real value in the improvement of any dairy product in which homogenization is involved.

It is assumed that although there are other factors which affect the results of homogenization, the principal effect is upon the size and frequency distribution of the fat globules.

It appears that a mathematical comparison of the size and frequency of distribution of the globules, together with weighted homogenization values for certain size globules, can be used to calculate the comparative efficiency of homogenization of various samples.

Authorities are in quite close agreement that a well homogenized sample of ice cream mix, for example, should have the fat globules 2 microns or less in diameter. They also agree that the size of fat globules in unhomogenized milk or cream will average somewhere in the neighborhood of 3½ to 4 microns, and that fat globules of greater than 2 microns diameter are undesirable in ice cream mix.

A technique of photomicrography has been developed which makes use of standard photomicrographic equipment for examination and photographing of samples in which the fat samples are first diluted with distilled water, then suspended in glycerine. The results obtained are superior in that the clusters and groups of fat globules are disturbed the very minimum and by means of improved illumination give excellent photographic detail.

A score card has been prepared for recording size and frequency of the various size fat globules and a formula is presented for mathematically evalu-

ating the percentage efficiency of homogenization, based upon the assignment of certain values to fat globules of each size ordinarily encountered. The values assigned are such that the normal unhomogenized mix will give a calculated efficiency of near zero while a well homogenized mix will show values near 90 per cent.

M18. A Simplified Solids Tester for Ice Cream. KENNETH M. RENNER, Texas Technological College.

A new type vacuum solids tester which can be assembled for a small cost, will be displayed. Results obtained in the testing of ice cream mix for total solids indicate that this method will check very closely with the Mojonnier Method.

The method involves the use of ordinary test tubes for holding the samples of mix. A water vacuum pump to furnish the vacuum and a Pyrex flask containing boiling water used as a heating medium. Thirty minutes is required to complete the test. A regular Butter Moisture Torsion balance is used to weigh the samples.

Total cost of equipment excluding the Torsion balance is approximately twelve dollars.

M19. The Effect of Certain Salts on Properties of Ice Cream Mixes. J. I. KEITH, C. W. RINK AND EARL WEAVER, Oklahoma A. and M. College.

Previously it had been found that sodium citrate and sodium bicarbonate decreased viscosity, fat clumping and titratable acidity (of ice cream mixes) and increased the stability of protein—when measured by precipitation with either alcohol or acid. Calcium chloride gave exactly opposite results in all particulars.

In a series of studies to determine the effect of calcuim chloride and sodium citrate on the development of sandiness in ice cream the following results have been obtained:

When control mix was used no sandiness developed in plain ice cream or in nut ice cream if the nuts had been treated with sugar syrup. When dry nuts were used sandiness developed in four months.

All ice cream made from mix to which calcium chloride had been added developed sandiness. Treating nuts with sugar syrup had little or no effect in retarding the development of sandiness when this salt had been added to the mix.

When sodium citrate was added to mix the development of sandiness was noticeably hastened if dry nuts were used and was slightly hastened when nuts were treated by simply pouring hot syrup over them before canning. No sandiness developed, however, in the plain ice cream or when nuts had been cooked in sugar syrup.

M20. Power Requirements for Freezing Ice Cream. W. J. CAULFIELD, C. K. OTIS AND W. H. MARTIN, Kansas Agricultural Experiment Station.

The operating efficiency of a 40 quart direct expansion freezer, operated with a 3 and 5 H.P. motor and using dasher speeds of 170 and 200 r.p.m., was determined. Other facts included in the study were the effect of shutting off the refrigerant at various temperatures, the percentage and kind of stabilizers used, and the use of egg yolk, on the power requirements for the freezer and the quality of the finished ice cream.

A reduction in the temperature at which the refrigerant was cut off from 25.5 to 24 and 22.5° F. resulted in noticeable increase in freezing time and total power required and a reduction in the speed of the dasher. When the ice cream drawn was at the lower temperatures the body and texture scores increased slightly.

The use of either gelatine or Dariloid in proper amounts affected the quality of the ice cream more than did a reduction in the drawing temperature. The time required for freezing, the total power required, and the score of the finished ice cream were not significantly different in the case of ice cream stabilized with 0.35 per cent of 250 Bloom gelatine as compared with a similar mix stabilized with 0.26 per cent Dariloid. The addition of stabilizer to a standard mix slightly increased the freezing time and total power.

When a 5 H.P. motor was substituted for the 3 H.P. no more total power was required to operate the freezer. The larger motor shortened the freezing time slightly and was never seriously over-loaded as was the 3 H.P. motor.

The addition of 1.5 per cent frozen egg yolks to the mixes increased the energy input to the motor to a marked extent when the refrigerant was cut off at 24° F.

The use of eggs shortened the freezing time, especially when the refrigerant was cut off at the lower temperature. No significant differences were observed in the quality of the ice cream as affected by the cut off temperature when eggs were used.

By increasing the dasher speed and using a 5 H.P. motor, a slight saving in time required for freezing resulted. There was a slight increase in the energy input to the motor but the total power for freezing was not affected. A change in dasher speed had no significant effect on the quality of the ice cream.

M21. Sogo Ice Cream. THOS. B. HARRISON AND C. E. WYLIE, University of Tennessee.

"Sogo" ice cream is ice cream that has been flavored with an improved grade of sorghum syrup made according to the method developed by the Agricultural Experiment Station of the University of Tennessee with the

cooperation of the Tennessee Valley Authority. This method of making good sorghum of uniform quality was used by the Cumberland Homesteads as Crossville, Tennessee, also by the Blanche Syrup Association, Blanche, Tennessee.

Frequently, ordinary sorghum syrup goes to sugar after being held awhile. Obviously, such sorghum would not be satisfactory as a flavoring for ice cream. The improved method of manufacture produces a uniform product and prevents the formation of sugar crystals.

In January 1937 several trial batches of ice cream, using varying amounts of sorghum, were made in the University of Tennessee Creamery. Interested parties were called in to pass judgment on the ice cream as to the flavor, texture, and color. From these trials it was decided that the best sample of the ice cream was the one to which sorghum syrup had been added at the rate of 1 pound to 5 gallons of ice cream. The following formula was used for the mix:

Ingredient	*Pounds*	*Fat*	*Serum Solids*
35% cream	25.2	8.80	1.47
4% milk	55.0	2.20	4.77
Skimmilk powder	4.4	.....	4.26
Sugar	15.0	.....	.....
Gelatine	.4	.....	.....
	100.0	11.00	10.50

The above mix was pasteurized at 150°, held for 30 minutes, cooled to 145°, and viscolized at 2500 lbs. pressure. From the viscolizer the mix passed over a tubular cooler where the temperature was reduced to 40°. The next morning the mix was frozen in a 20-quart direct expansion freezer. The sorghum syrup was added to the mix in the freezer. After freezing, the ice cream was hardened and stored at 0° F.

M22. Flavor Defects Encountered in Strawberry Ice Cream Prepared with Commercial Skim Milk and Condensed Milk from Stainless Steel Pans. E. W. Bird, J. J. Willingham and C. A. Iverson, Iowa State College.

The objectives of this problem were to:

1. Compare the keeping quality of ice creams made with condensed milk from stainless steel pans with that of samples prepared with dry skim milk.

2. Determine whether or not the heat treatment of fat is a factor in the development of the flavor defect by comparing ice cream prepared with 8 per cent fat and skim condensed milks which have been processed in stainless steel pans.

3. Compare the effect of age of condensed milk (from stainless steel pans) on the keeping quality of the ice cream made. The comparison was attempted by preparing ice cream with fresh and one week old skim and 8 per cent fat condensed milks.

4. Further check whether or not strawberries contribute to the development of the flavor defect by comparing storage quality of ice creams from the same mix prepared with and without fruit.

5. Check the hypothesis that copper is contributory in the development of the undesirable flavor from a catalytic standpoint rather than that its presence in any mix might assure the occurrence of the defect. That is, previous work at this station indicates that the rate of development of the flavor is proportional to the copper content in those samples in which the defect occurs but that many samples with equivalent or higher copper contents do not show the defect. It would appear then, that copper does catalyze only those samples which seem to have the tendency to oxidize inherent in them, whereas its presence in samples not so predisposed does not cause flavor defects.

The experimental data indicate that:

1. The copper content of the ice cream samples was not appreciably altered by the addition of strawberries.

2. The stale flavor defect as encountered in this study was very mild and was not pronounced enough to cause a great deal of trouble.

3. The metallic and tallowy flavor defects were very objectionable and the ice cream was unpalatable when they were present.

4. The heat treatment of the fat during the condensing process in stainless steel pans had no apparent effect on off-flavor development.

5. The age of the condensed milk, when stored for one week at 32° F., had little effect on the off-flavor development.

6. Strawberries tended to retard the development of off-flavors.

7. The presence of copper in the ice cream does not assure the occurrence of the defects. The state in which the copper is present appears to be more important. Copper may act as a catalyst but apparently oxidizes only those samples that have the tendency to oxidize present in them.

8. The use of condensed milk prepared in stainless steel pans as a source of added solids in ice cream does not introduce the flavor difficulties that have been encountered when condensed milk from copper pans is employed.

9. The comparison of the flavors of ice cream containing commercial condensed milk processed in stainless steel pans with those containing commercial dry milk as the source of added solids showed that those samples prepared with the condensed milk were superior in quality to those prepared with dry skim milk.

M23. Some Factors Affecting the Serving and Dipping Qualities of Ice Creams.* W. H. E. Reid and W. S. Arbuckle, Missouri Agricultural Experiment Station.

This investigation treats with the effect of serving temperature on consumer acceptance, dipping qualities and stability of ice creams and sherbets.

The consumer acceptance was determined by recording the observations made by a comparatively large number of different people who judged seven different flavors of ice creams and four sherbets at serving temperatures of 6, 10, 14 and 18° F. The data indicate definitely that the serving temperature is a factor of decided importance in determining consumer acceptance of frozen desserts.

Ice creams served at 10° F. were considered by a large per cent of the judges, as being desirable in flavor, smooth and mellow in body and close in texture. Those served at 14° F. were considered very slightly objectionable because of the tendency for the flavor to be too pronounced, sweet and warm, the body tended to be slightly lacking in resistance and the texture was slightly open. At 6° F. the ice creams were severely criticized for having a cold, submerged flavor and resistant body. All ice creams were least desirable for consumption when served at 18° F.

Due to the higher sugar content and more pronounced flavor, sherbets were preferred at a slightly lower serving temperature than was ice cream.

As the serving temperature of the ice creams and sherbets was increased, the flavor became more pronounced. A serving temperature of 10° F. imparted the most desirable flavor to the frozen desserts. The flavor was submerged and the ice creams considered too cold when a lower temperature was used. However, the flavor was described as being somewhat too pronounced, sweet and warm when served at a temperature exceeding 10° F.

The dipping studies indicate that smaller portions of ice cream were dipped when temperatures of 6° and 10° F. were used.

Serving temperatures appeared to have little effect upon stability of ice cream; however, the ice creams became undesirable for consumption much faster when the smaller sized dippers were used.

M24. Volumetric Method for the Determination of Diacetyl. H. A. Ruehe and W. J. Corbett, University of Illinois.

The authors have developed a simple and rapid volumetric method for the determination of diacetyl in starters. They suggest the following procedure:

1. Prepare starter distillate according to the method suggested by Hammer, *i.e.*, add 40 ml. of 40 per cent $FeCl_3$ to 200 ml. of starter. Steam distill

* Contribution from the Department of Dairy Husbandry Missouri Agricultural Experiment Station Journal Series No. 509.

until 100 ml. of distillate is collected. By this procedure the acetylmethyl carbinol in the starter is changed to diacetyl and this product is distilled off and collected in the distillate.

2. Divide distillate into two portions of 50 ml. each for duplicate determinations.

3. Neutralize acidity of distillate with 0.05N NaOH, using phenolphthalein indicator.

4. Add about 1 to 2 ml. of 30 per cent H_2O_2. (One ml. of the H_2O_2 sufficient to oxidize 100 mg. of diacetyl.)

5. Add one drop of a 0.01 per cent solution of osmic acid. (Take 0.01 gram perosmic anhydride and make up to 100 ml. solution with distilled water.)

6. Allow solution to stand about 3 hours after adding the H_2O_2.

7. Titrate to faint pink with 0.05N NaOH, using phenolphthalein indicator. (Proper end point when faint pink color remains about 20 seconds and after fading one drop of alkali solution will bring back pink color.)

8. Calculate mg. diacetyl as follows:

Ml. NaOH × normality × 43 = mg. of diacetyl in 50 ml. of distillate.
Multiply this result × 2 to obtain total mg. of diacetyl in 200 ml. starter.

This method of determining diacetyl is based on the reaction that H_2O_2 oxidizes one molecule of diacetyl into two molecules of acetic acid.

$$2\,CH_3\,COCOCH_3 + 2H_2O_2 \xrightarrow[\text{acid}]{\text{osmic}} 4\,CH_3COOH + O_2$$

M25. The Influence of Heated Testers and Composite Tests on the Babcock Test. P. S. Lucas, Michigan State College.

Misunderstandings concerning the testing of dairy products cause almost as much unrest among dairy farmers as do prices paid for the product itself. Two factors have been mentioned consistently by producers in Michigan during the past two years. The first of these was their conviction that tests from a properly heated tester were more uniform, were more nearly accurate, and were higher. The second was their belief that composite samples give test results lower than the average of dairy tests. Experimental trials seemed desirable before request should be made for legal regulation of either or both.

Three temperatures were used in testers during the trials made with over 500 samples. The average of samples run in heated testers were higher but statistically the results were not significant. The Mojonnier test gave results averaging .07 of 1 per cent lower than the Babcock. This result, statistically, is significant. Residual fat left in the bulb of the bottle was higher in the case of tests made in unheated testers but so variable as not to be significant.

Due to possibility of evaporation, composite samples should, theoretically, result in higher tests than daily averages. This was not true, however. Selection of samples for eight days taken at random during any month gave practically as good results as daily tests, but four day tests gave such variable results as to make the practice unreliable.

M26. Removal of French Weed Flavor from Cream. W. B. COMBS AND S. T. COULTER, University of Minnesota.

French weed (*Thlaspi arvense*), fan weed or stink grass is known to be responsible for a pronounced obnoxious flavor in milk when consumed by the dairy cow. The use of such chemicals as sodium or calcium hypochlorite, chloramine T, sodium tetraborate (borax) and sodium nitrate in cream intended for buttermaking is unlawful according to Federal and State laws. These chemicals, veiled under certain trade names, are being sold to the creamery industry as sterilizers and in washing compounds. Verbal directions are frequently furnished with reference to the use of these chemicals in the elimination of certain weed flavors, including onion and garlic, from milk or cream. In addition, such products as "Listerine" and brown sugar alone or in combination with other chemicals have been added to cream possessing the flavor of French weed in efforts to overcome the off flavor. Each of these chemicals, in varying amounts, were added to sweet cream possessing a strong French weed and garlic flavor and to sour French weed cream. The butter churned from these creams was examined in the fresh state and after storage.

Boiling the cream in a vacuum pan was the most effective method of treating garlic or French weed flavored cream.

M27. Effect of Temperature on the Rate of Deterioration of Cream. W. H. MARTIN, A. C. FAY AND W. J. CAULFIELD, Kansas Agricultural Experiment Station.

Renewed interest in cream improvement has been experienced in all parts of the country, particularly in the Middlewest, as a result of the Federal Food and Drug Administration efforts to improve the quality of creamery butter. To study the chemical and bacteriological changes taking place, split samples of cream were held at several storage temperatures. The samples were graded daily, and pH, titratable acid, and formol titrations were determined. In two of the six trials yeast and mold counts and also differential and total bacteria counts were made daily on the cream. In one trial starter was added to one part of a split batch of cream for comparison with the part containing no starter. The keeping quality of butter made from cream after it became second grade was also determined in two trials.

Average number days required for cream to become second and third grade when held at various temperatures

	TEMPERATURE OF INCUBATION								
	50	55	60	65	70	75	80	85	90
Days required to become second grade	15	11	10	9	6	5	3	3	2
Days required to become third grade	16+	15	13	13	9	8	6	5	4

At 50° F. and 60° F., the rates of growth of yeast and mold were relatively low; whereas at 70° F. or higher these micro-organisms grew rapidly. A close correlation existed between the titratable acidity and hydrogen ion concentration. Both increased slowly at 60° F., but at 70° F. and 90° F. the rate of development was accelerated and the total amount of acid produced was much greater than it was at lower temperatures.

There was nothing in the data to indicate that the addition of starter to the cream to encourage acid production and discourage protein decomposition was feasible. The formal titration was used as a measure of the extent to which protein was broken down. Time, temperature and the addition of starter were factors which affected the formal titration. However, further work will be required before any conclusion can be drawn on the value of formol titration as a measure of cream deterioration.

Butter made from high acid cream, which was only a few days old, deteriorated rapidly on storage. Fair quality butter which stood up well in storage was made from the low acid cream even though it was several days old. The best butter, as to be expected, was made from the fresh low acid cream.

M28. Some Aspects of the Reduction of Acidity in Cream for the manufacture of Butter. E. W. Bird, N. E. Fabricius and D. F. Breazeale, Iowa State College.

Four acid-reducing agents (sodium carbonate, sodium sesquicarbonate, a fused sodium carbonate-bicarbonate mixture and a magnesia (dolomitic) lime) will be reported. Factors investigated over a pH range, in butter, from 5.3 to 8.0 were: (1) Churning losses as percentage total fat churned; (2) comparison of titratable acidity obtained and that desired; (3) comparison of titratable acidity and pH of cream; (4) comparison of pH of cream at churning time and pH of butter serum 3 to 4 days after manufacture; (5) change of pH of butter serum during storage; (6) change in titratable acidity of fat of butter with pH of cream; (7) change of titratable acidity of fat during storage, and (8) correlation of initial and storage scores and flavors of butter with initial and final pH of butter serum.

The results indicate that: (1) Churning losses are minimal in the region pH 6.7 to 7.0 regardless of the neutralizer. This indicates that casein once acid coagulated is not dispersed in a condition comparable to that of sweet cream until the cream is nearly at the neutral point. (2) Non-buffered alkalies (as lime) reduce the acidity of cream linearly to acidities at least as low as 0.0 per cent. Buffered alkalies (*cf.* carbonate combinations) yield linear acid reduction to acidities as low as 0.15 to 0.20 per cent; below these points the rate of reduction of titratable acidity becomes progressively slower. With all neutralizers studied the acidities are lower than desired in the higher ranges and higher than desired in the lower ranges. (3) With the buffered "soda" neutralizers the pH of the cream varies smoothly with titratable acidity from 0.1 to 4.0 per cent acidity. The magnesia lime curve varies smoothly from 0.4 to 0.22 per cent acid; from 0.22 to 0.15 per cent the pH is practically constant indicating precipitation of $Ca_3(PO_4)_2$ and from 0.15 to 0.0 per cent the curve is linear with very sharp rise in pH. (4) The curves for pH of cream *vs.* pH of butter progress smoothly from pH 5.5 to 8.0 when soda neutralizers are used. With magnesia lime a smooth curve is obtained from pH 5.5 to pH 6.25; from pH 6.25 to 7.0 in butter the cream pH varies only from pH 6.3 to 6.6 while above pH 7.0 the two values yield a linear graph. (5) All buffered neutralizers tend to yield a slight increase in pH of butter serum during storage while non-buffered yield random variation with a somewhat greater tendency toward increase than toward decrease in pH. No variations greater than 0.2 pH were encountered. (6) The titratable acidity of the fat of butter progressively decreases with increase in pH of cream (7) Relatively little change in titratable acidity of the fat occurs during storage. (8) The initial pH correlates better with the storage than with the initial score of butter. Regardless of the neutralizer the region of least flavor defect development and of best maintenance of score seems to be pH (initial) 6.7 to 7.5. The pH is apparently not the only factor influencing butter score for the acidity of the fat is of importance. It should be noted in this connection that the fat acidity is a function not only of the pH of the cream at the time of churning but also of the age and quality of the cream.

M29. Studies in the Keeping Quality of Butter Made from Sour Cream.

J. C. Flake and E. H. Parfitt, Purdue University.

The keeping quality was determined on 343 samples of commercial butter made from sour cream. This butter was produced in Middlewestern plants during the period of September, 1936, to February, 1937. The butter was scored, then incubated for 10 days at 15.5° C., and rescored. In addition, chemical and bacteriological studies were made. The results obtained are as follows:

1. Of all samples, 29 per cent did not drop in score during the incubation period; 44 per cent dropped 0.5 to 1.0 point; 15 per cent dropped 1.5 to 2.0 points; 12 per cent dropped 2.5 to 3.0 points.

2. The samples having an original score of 91 or higher showed an average drop in score of 2.0 points; none showing a drop of 0. Those scoring 90 to 90.5 had an average drop of 0.907 point, with 28 per cent not dropping in score. Those scoring 89 to 89.5 had an average drop of 0.748 point, with 45 per cent not dropping. The samples scoring 88.5 or less dropped an average of 0.767 point, with 32 per cent not dropping.

3. The microscopic picture of the butter showed that, in general, large numbers of rod shaped organisms are associated with poor keeping quality.

4. High lipolytic counts of the butter after storage had a tendency to be associated with poor keeping quality. Samples developing a putrid flavor were most marked in this respect. Samples which developed rancid or old cream flavors also tended to have higher lipolytic counts than did the samples which failed to drop in score. High proteolytic counts showed a slight tendency to denote poor keeping quality.

5. Of the samples which did not drop in score, 11 per cent fell in the range of pH 5.5–6.0; 48 per cent in the range of pH 6.0–6.5; and 22 per cent in the range of pH 6.5–7.0. Of the samples dropping ½ to 1 point in score, 13 per cent were in the pH range of 5.5–6.0; 38 per cent in the range of 6.0–6.5; and 33 per cent in the range of 6.5–7.0. Of those dropping 1½ to 2 points, 14 per cent showed a pH of 5.5–6.0; 34 per cent a pH of 6.0–6.5; and 35 per cent a pH of 6.5–7.0. Of those dropping 2½ to 3 points, 20 per cent were in the range of pH 5.5–6.0; 23 per cent from pH 6.0–6.5; and 35 per cent from 6.5–7.0.

6. The pH distribution of samples developing specific off-flavors showed that putrid flavor is associated with the higher ranges, especially around pH 6.75 to 7.25. Those developing old cream flavor fell in the medium range especially around pH 6.25. Those developing rancid flavor fell in the lower range, especially from pH 5.5 to 5.75.

7. In the distribution of samples as to salt percentage, those developing putrid flavors and those not dropping in score tended to be in a lower range than did the samples which developed rancid or old cream flavors. Falling in the range of 2.0 to 2.49 per cent salt were 55 per cent of the samples which did not drop in score and 61 per cent of the samples which developed putrid flavors. In the range from 2.5 to 2.99 per cent salt were 50 per cent of the samples which developed rancid flavors and 44 per cent of those which developed old cream flavors.

M30. Notes on Problems Confronting the Industry on Quality Improvement of Creamery Butter. M. E. PARKER, Chairman of

Research Committee, American Assn. Creamery Butter Mfgrs., Chicago, Illinois.

Quite aside from the problems involved in the procurement of raw cream supplies there are many questions concerning production development and quality maintenance of creamery practices which merit the attention and study of scientific investigators.

While the American Dairy Science Association has been pioneering the application of the Kohman test for the composition of creamery butter, its utility can be seriously threatened unless greater uniformity of results between qualified laboratories can be assured.

The determination of yeasts and molds in butter has proven a boon to those interested in the control of creamery sanitary practices. Yet, present methods using potato dextrose agar have proven somewhat questionable in the examination of unsalted butter, although the newer method of preparing dilutions as indicated by Parfitt has been a distinct improvement.

A virgin field for scientific exploration and also of service is available to the scientific investigator who can solve the problem of the loss in weight in packaged butter. The true significance of the acidity of butter sera, as well as, its proper determination as expressed by pH values is still undetermined. The presence of *Escherichia coli* in butter has not been satisfactorily investigated, nor its significance properly evaluated. The quantitative determination of the color and the vitamin contents of butter produced under a variety of seasonal and sectional conditions can not be long deferred if its nutritional properties are to be maintained or enhanced.

M31. Overcoming the Gummy Body of Butter Caused by Feeding Cottonseed Meal. J. I. Keith, C. W. Rink and A. H. Kuhlman, Oklahoma A. and M. College.

The milk from a herd of Jerseys fed only cottonseed meal and prairie hay and the milk from a similar herd of Jerseys fed a normal ration was collected and separated daily. The two kinds of cream were accumulated and churned. Cream and butter from the former are designated as "cottonseed meal" and from the latter as "normal."

Fifty gallon batches of each kind of cream were pasteurized and cooled in the regular manner. Half of each batch was churned immediately while the other half was held cold for two or four hours before churning.

It was found that when cream was held cold for only 2–4 hours before churning, the "cottonseed meal" cream required 20–30 per cent longer time to churn; whereas previous work had shown that 50–60 per cent longer time was required when the cream was held over night. When churned in less than one hour after cooling, the "cottonseed meal" cream churned in about the same time as the "normal" cream.

When cream was held 4 hours before churning, the "cottonseed meal" butter had a pronounced gummy body. This defect was less noticeable when the cream was held for only two hours; and was not evident when the cream was churned in less than one hour after cooling.

M32. The Lactic Acid Content in Butter, Progress Report. B. E. Horrall and W. F. Epple, Purdue University.

The lactic acid content of butter and the cream from which the butter was made was determined by the methods of Troy and Sharp, and Friedemann, Cotoni and Shaffer. These methods were comparable since the results checked within experimental error.

A study was made of the lactic acid content of butter made from cream of various acidities as determined by the regular titration method. The following problems were studied:

(1) Lactic acid was added to the cream to make the titratable acidities of 0.3%, 0.5%, 0.8%, 0.8% neutralized to 0.2%, and 0.8% neutralized to 0.2% and lactic acid added to 0.3%. These various lots of cream were then churned and the resulting butter analyzed for lactic acid.

(2) The above procedure was repeated, substituting a good quality starter instead of lactic acid.

(3) The lactic acid content of twenty churnings of commercial butter was studied. This study included the lactic acid content of the raw cream, cream after neutralization and pasteurization, cream at the churn, buttermilk, and the butter. The pH and titratable acidity were also determined on all samples.

(4) The lactic acid content on various samples of commercial butter sent to the Experiment Station for analysis was determined. These samples were subjected to a keeping quality test consisting of an incubation period of 10 days at 62° F. and another lactic acid determination was made. Some of the samples dropped in score from 1 to 3.0 points during the incubation period.

M33. pH Range of Centralizer Butter. W. H. Brown and E. H. Parfitt, Purdue University.

Approximately sixty-five dairy plants, manufacturing butter in Indiana and neighboring states, have been submitting monthly samples of butter to Purdue University for analysis. The hydrogen-ion concentration, expressed as pH, has been determined on the serum of the butter using a quinhydrone electrode.

1. Since March, 1935, the butter manufacturers have been gradually shifting the pH of the butter toward the neutral point, or pH 7.0. In 1935, the pH range of the largest number of samples was from 6.01 to 6.25; in

1936, the range was from 6.26 to 6.50 and to date (April, 1937) the range was from 6.5 to 6.75.

2. The range in pH of 892 individual samples was from 8.0 to 4.15 and of all the samples 9.42 per cent were over pH 7.0; 29.71 per cent from pH 7.0 to 6.51; 38.23 per cent from pH 6.5 to 6.01; 16.70 per cent from pH 6.00 to 5.51; 3.48 per cent from pH 5.50 to 5.0 and 2.24 per cent below pH 5.0.

3. During 1936 no seasonal trend in pH occurred.

4. The pH of the butter produced in some of the plants which have control laboratories varied over wide and narrow ranges.

5. The pH of the samples criticized as having either a slight or a distinct neutralized flavor ranged from 4.15 to 7.96.

M34. Microflora of Cheese Slime. H. MACY AND J. A. EREKSON, University of Minnesota.

Studies have been made of the microflora of the slime appearing on Roquefort, Port du Salut, Tilsit and Limburger types of cheese during the ripening periods. Remarkable changes in pH occur along with modifications of the flora. Cause and effect in this phenomenon are not yet clear. The development of yeasts in the slime of the Roquefort type is followed by a dominance of micrococci and rod forms especially of the *Bacterium linens* type. Microscopic examination of old Roquefort slime revealed degeneration of the bacterial cells, which corresponded with a sudden drop in plate counts.

Rod forms with atypical yeasts were found in old slime of Port du Salut and Tilsit cheese, while Limburger slime showed rod forms in predominance.

The orange pigment-producing rods in the slimes studied apparently were *Bacterium linens* or related strains:

Further studies have been made upon characteristics of the slime organisms and factors influencing the development of the characteristic "rouge."

M35. Making Cheddar Cheeses from Low Curd Tension Milk. J. C. MARQUARDT AND G. J. HUCKER, New York Agricultural Experiment Station.

The low curd tension milk used in these studies was obtained from a herd of cows infected with mastitis. For the experimental work the entire milk production of the herd was used. This included milk from inflamed quarters, although the mixed milk appeared normal macroscopically.

The experimental milk was made into 5 batches of cheese on 5 consecutive days. Two controls from normal milk were also made. The experimental milk contained *Streptococcus agalactiae* and more than 500,000 cells per cc. The experimental milk gave very low curd tension readings by the

Hill and Miller tests. It fell within the range of soft curd milk. Using these tests without $CaCl_2$ or HCl added there was no curd formation. Likewise the experimental milk did not form a curd in the Marschall Cup test. Titrations and pH value determinations indicated that the normal milk was more acid in reaction than the milk from the experimental herd.

It was possible to make the experimental milk into satisfactory cheeses by using 0.5 to 1.0 per cent of starter plus 30 per cent HCl at the rate of 100 cc. per 1000 pounds of milk. This was not recommended because of technical limitations and the dangers involved in adding inorganic acids to food products. By adding starter ranging from 1½ to 3 per cent it was possible to make satisfatcory cheese from the experimental milk. For this procedure the Marschall Cup or a like test is imperative. The limitations of this suggestion in practice is the lack of clean starters and the unwillingness of most cheese makers to use more than 1 per cent of starter.

These studies were not intended to encourage making cheese from mastitis milk. It is hoped that milk of this kind will gradually be reduced to a minimum in cheese sections.

The controls and the cheese made from the experimental milk were rated at 3 regular periods ending with a 9 months' inspection. The cheeses were scored by 3 station men and by 2 cheese dealers. The ratings of all were comparable without significant deviations.

Streptococcus agalactiae survived in the cheese at the close of the 9-month scoring period.

Field experiments indicated that dealers are experiencing difficulties with cheeses made from mastitis milk supplies. Many unusual practices without scientific foundation have been introduced by the industry in an attempt to make favorable cheeses from mastitis milk.

M36. Curd Tension Measurements. L. H. BURGWALD AND T. V. ARMSTRONG, Ohio State University.

Four different types of curd knives were used in this study. The average of the curd tension measurements secured with the American Curd-O-Meter was approximately four grams higher than those secured with the original Hill knife, with the Sommer knife and the Submarine knife giving tensions between these two limits.

Two separate readings were secured during each curd measurement with the knives which operate with a downward thrust: (1) the maximum curd tension, or that reading observed when the knife is cutting through the surface of the coagulum, and (2) the actual tension, secured while the knife is cutting through the body of the curd. The American knife exhibits an average variation, between this actual tension and maximum tension, of 8.3 grams. The difference shown by the Sommer and Submarine knives are 2.6 grams and 6.4 grams, respectively.

Increasing the cutting speeds of the knives resulted in a lowering of curd tension measurements, while decreasing the speed resulted in a corresponding increase in these measurements for the few samples that were tested in this manner.

Twenty-seven coagulants were used consisting of variations in amounts of the Hill Reagent and variations in volume and concentration of hydrochloric acid containing different percentages of pepsin.

The reduction of the Hill Reagent to 6 cc. amounts resulted in increased curd tensions in each case.

The use of 10 cc. of N/10 HCl gave curd tension measurements slightly greater than those obtained with the same amount of N/6.67 HCl, the pepsin content being the same in each determination.

Slight increases in pH of the mixtures of milk and coagulant contributed to a tendency toward higher curd tensions, while decreases in pH showed a corresponding decrease in curd tension. The use of 10 cc. of the Hill Reagent resulted in mixtures which gave lower pH readings than were found with any coagulant used, except those where the concentration of HCl was greater than N/6.67.

Variations in time between adding the coagulant and cutting the curd exerted an appreciable influence on the resulting curd tension. The curd tensions increase with increased setting time; one minute variations from the standard ten minute period had no appreciable effect.

The addition of coagulant to the milk as compared with the addition of milk to coagulant resulted in a marked difference, both in the resulting curd tensions and the character of the curd. Twenty-seven comparative tests made, using three different samples of milk, gave average actual tensions of 26.1 grams by adding the milk to the reagent, while the same milk with coagulant added, gave average actual tensions of 58.9 grams.

M37. The Effect of Varying Storage Temperatures and The Effect of Coverings on the Ripening of Cheddar Cheese. W. G. McCUBBIN AND E. L. REICHART, University of Nebraska.

Part I—Twelve-ounce prints of Cheddar cheese were ripened in valve-vented cans at 70° and 40° F. or combinations of these two temperatures and scored at 1, 2, 3, 4, 5, and 6 months of age. Cheese ripened at 40° F. continuously was superior in both body and flavor. Cheese exposed to the 70° F. temperature for any appreciable length of time became very gassy and developed a fruity, fermented flavor.

Part II—Five-pound oblong loaves of cheese were covered with paraffin, paraffin plus cellophane, and parafilm, and some of these loaves were ripened at 70° F. and some at 40° F. Cheese ripened at 40° F. developed a much milder flavor and lost less moisture than cheese ripened at 70° F. Loaves covered with parafilm and paraffin plus cellophane developed an unclean

flavor which was not prevalent in the paraffined cheese. This unclean flavor was especially noticeable in the cheese ripened at 70° F. Comparative moisture tests at the end of the fifth month of ripening revealed that the parafilm covered cheese contained about 2% more moisture than the cheese covered with paraffin plus cellophane, and the cellophane covered cheese contained from 3 to 4% more moisture than the paraffined cheese. Mold growth was very prevalent on the cheese covered with cellophane.

M38. Cheese Freezing and Curding Investigations. J. C. MARQUARDT, New York Agricultural Experiment Station.

The disadvantages of storing cheeses for long periods of time at a few degrees below their freezing points is apparent to those who handle cheese. Previous investigators have shown certain limitations of freezing and holding cheeses at temperatures ranging from 0 to – 10° F.

This investigation was planned to study the problem of freezing cheeses as a means of studying certain curing changes. Its practical application deals with the freezing of a wide variety of cheeses for storage and quality reasons.

Several noteworthy observations have been made. It has been possible by freezing and storing at – 10° F. to retard the development of a bitter flavor in Limburger type cheeses. It is well known that the control of this defect is difficult when Limburger type cheeses are stored at 34° F. for periods ranging from 9 to 12 months.

The texture of aged cheddar cheese has been improved by freezing and storing at – 10° F.

It has been possible to freeze successfully and to hold at low temperature the following cheese variations: Muenster, Limburger, cheddar, camembert and low moisture content grating type cheeses.

The advantages of removing the cheeses directly to a 70° F. room from the – 10° F. room are being compared with placing the cheeses for an 18-hour period at 34 to 40° F. before placing them in a 70° F. room.

Freezing cheeses for prolonged periods of time offers chances for studies in the fundamentals of cheese ripening. For example, pH control with prolonged cold storage periods at – 10° F. will afford a chance to regulate bacterial growth and enzyme activity to a degree estimated to be sufficiently sensitive to make certain general observations at least concerning the active agencies in the curing of cheese.

Curing investigations have revealed that temperatures and humidities employed must be selected for more than flavor production in the cheeses. Rind formation is very essential.

The advantages of holding cheddar type cheeses for a period of time (above 10 days) before being cured at 34° F. over placing them in the 34° F. room within a few days after making is also being studied.

These apparently simple matters are rather difficult to solve due mainly to the wide range in quality of commercial cheeses when compared to experimental cheeses.

M39. Studies Relative to an Open Flame Method for Determining the Moisture Content of Cheddar Cheese. I. A. GOULD, Michigan State College.

A preliminary report of studies being carried out to determine the practicability and accuracy of using a method for determining the moisture content of cheddar cheese similar to the open flame method generally used for butter. Dried olive oil was used in the moisture pans in an effort to prevent the cheese from sticking and burning during heating. Analysis of 31 non-sputtering samples of cheese were made in which results secured by the olive oil-open flame method were compared to those obtained by the use of the Mojonnier method, slightly modified, and by the use of the steam pressure oven operated at approximately 85 pounds pressure. The average moisture values for the samples were 36.45 per cent by the Mojonnier method, 37.19 per cent by the steam oven method, and 36.75 per cent by the oil method. Approximately 40 per cent of the cheese samples encountered sputtered too badly to be accurately analyzed by the olive oil method. Also, when this method was used, the cheese particles usually tended to lump together and to stick to the bottom of the pan during the heating process. The addition of approximately one gram of sodium chloride to the oil prior to addition of the cheese, prevented sputtering in practically all cases, and also prevented the cheese from lumping and sticking. The average moisture content of 20 samples of cheddar cheese by the salt-olive oil procedure was 36.61 per cent as compared to an average of 36.06 per cent by the Mojonnier method. An analysis of 17 samples showed the salt-olive oil method to give results averaging within 0.1 per cent of those secured on the same samples using the steam oven at 85 pounds pressure.

M40. The Homogenization of Milk for Blue Cheese. C. B. LANE AND B. W. HAMMER, Iowa State College.

Comparisons of cheese made from unhomogenized and from homogenized milk have been continued. With the homogenized milk a somewhat different making procedure is necessary than with unhomogenized milk. After a few weeks ripening, the cheese made from homogenized milk began to develop a blue cheese flavor, and after 2 or 3 months considerable of the sharp, peppery flavor was present. With the control cheese, no blue cheese flavor was detected for 3 or 4 months and then the flavor was commonly still somewhat unclean and lacking. In general, cheese made from homogenized milk was soft in body and had a relatively light color, while the control cheese was comparatively hard and yellow in color.

Studies on the volatile acidity of the cheese and the acidity of the cheese fat showed that the values obtained on the cheese made from homogenized milk were two to four times as high as those obtained on the control cheese. Cheese made from milk which had been pasteurized and then homogenized gave higher values than the control cheese but the values were considerably lower than those obtained on the cheese made from raw homogenized milk.

Cheese made from cows' milk or goats' milk, with and without homogenizing, was compared. Data on the flavor during ripening showed that, in general, the cheese made from homogenized cows' milk scored highest while that made from homogenized goats' milk was the next highest. The cheese made from milk not homogenized still had very little flavor after 3 or 4 months' ripening.

M41. Studies on the Ripening of Blue or American Roquefort Cheese. S. T. Coulter, W. B. Combs and Spencer George, University of Minnesota.

A rather extensive experiment has been completed attempting to determine the effect of variations in acidity at the various steps in the manufacture of Blue or American Roquefort cheese, on the rate of ripening and the quality of the cheese. Factors varied were the amount of starter, the acidity of the milk at setting, the acidity at dipping and the acidity at hooping.

The observations included the hydrogen ion concentration during various stages of manufacture and ripening and the fat hydrolysis and protein decomposition at regular intervals during ripening. Included in the data are the analysis for fat, salt and total solids of the fresh cheese and of the cheese at intervals during ripening.

The quality of the cheese was not influenced significantly by variations in the acidity during manufacture. In general, low acidities during manufacture favored fat hydrolysis and protein decomposition.

M42. Studies on the Ripening of Blue Cheese. C. B. Lane and B. W. Hammer, Iowa State College.

When cheese is made from homogenized milk there is commonly a definite rancidity developed during the manufacturing process. Rancidity becomes more pronounced as the ripening progresses; the green cheese may be very rancid before there is any conspicuous mold growth and when control cheese made from unhomogenized milk still shows no flavor suggesting fat hydrolysis. Some lots of cheese rather quickly show the odor of methyl n-amyl ketone and this may be so pronounced that it is objectionable. Eventually the rancidity and ketone flavors blend in with the flavors due to the higher fatty acids and a more desirable condition results. The possibility of the destruction of fatty acids through the activity of the mold must also be recognized.

A small amount of mold powder (0.01 per cent) was sufficient to produce satisfactory mold growth in blue cheese. The mixing of the powder into the curd immediately before hooping brought about a more uniform distribution of mold growth in the ripened cheese than when the usual method was employed in which the powder was sprinkled on layers of curd in the hoop; in addition, the former method prevented powder streaks in the cheese.

Cheese was made from raw and pasteurized skim milk to which boiled cream, raw cream or butter was added to obtain a fat percentage comparable to whole milk; the mixtures were homogenized under 2,500 pounds pressure at 90° F. Examinations during ripening indicated that the cheese made from raw skim milk plus the fat ingredients developed the flavor regularly obtained in young cheese made from homogenized, raw whole milk; the flavor developed rapidly in the cheese before any apparent mold growth. In comparison, the cheese made from pasteurized skim milk plus fat ingredients did not have a rancid flavor until the mold developed.

Small units of blue cheese, weighing about 2 pounds each, were made in special hoops. The cheese ripened satisfactorily although a longer period was generally required than with normal size cheese, due presumably to the tendency of the small units to dry out.

M43. The Influence of Steapsin on the Rate of Ripening Blue or American Roquefort Cheese. W. B. COMBS AND S. T. COULTER, University of Minnesota.

The work of Currie from which the author concludes that the characteristic peppery taste of Roquefort cheese is due to the hydrolysis of fat by lipase secreted by the mold *Penicillium roqueforti* is generally accepted. To develop a pronounced peppery flavor in Blue or American Roquefort requires from 7 to 9 months. In efforts to shorten the period required to develop the characteristic flavor, the authors have added varying amounts of either steapsin or castor bean lipase to milk intended for manufacture into Blue cheese. The resulting cheese developed a pronounced peppery flavor in 4.5 to 5 months. Though the flavor is not typical, it is relished by many. The cheese has proved of particular interest to those manufacturing cheese spreads since its flavor is so pronounced and less cheese is required to secure a trace of Roquefort flavor in the finished product.

M44. A Photomicrographic Study of Processed Cheese. HUGH L. TEMPLETON, University of Wisconsin.

From the appearance and behavior of experimental samples of processed cheese made with varying amounts of the emulsifying salts that are commonly used, it is evident that the salts must exert considerable influence upon the body and texture of the finished product. In an effort to study these differences microtome sections of the various samples have been prepared

and studied under a magnification of 230. The sections of cheese used were 20 microns in thickness and were stained with Sudan III to facilitate the identification of the fat. Photomicropraphs were made of characteristic fields as viewed under the microscope. These pictures show that there are decided differences in the structure of the cheese and the distribution of the fat within the cheese.

For purposes of comparison photomicrographs are also presented of the cheese before it was processed, and in the case of two samples, portions of the cheese were removed at different stages of the processing operation. From these pictures it is evident that there are stages in the processing in which the fat in the cheese is to be found in rather large masses. These are broken up during the subsequent heating and agitation so that the fat in the finished product is usually found in a more finely divided form. In one case in which there was a marked fat separation during the heating, the fat in the final product occurred in large masses.

This method of study offers an excellent opportunity to investigate the solubility of the emulsifiers that are used. In the experimental samples studied, the salts were always added in a dry form at the start of the processing operation. In the case of the samples containing 2 and 3 per cent of Rochelle salt, microscopic crystals were very noticeable. These crystals might be either the undissolved Rochelle salt or calcium tartrate formed by the interaction of the emulsifier with the calcium of the cheese.

Pictures representing characteristic fields of commercial samples of processed cheese are also presented. These show variations in texture and fat globule size which are apparently related to the method in which the cheese was treated mechanically as well as to the salts that were used as emulsifiers.

M45. Influence of Manufacturing Methods upon the Acidity of Brick Cheese. D. W. Spicer and Walter V. Price, University of Wisconsin.

The effects of certain manufacturing practices upon the developed acidity of Brick cheese were studied experimentally using *S. lactis* for starter. Variations in amounts of starter, time of "ripening," temperatures of heating and times of dipping seem to indicate that excessive acidity in the finished cheese can be caused by either too little or too much acid development during curdmaking or by too slow or too rapid acid development before dipping. With milk of good quality, the best results followed making procedures so regulated that in a 2 hour lapse of time between cutting and dipping there was developed in the whey 0.02 per cent of titratable acidity.

M46. Relation Between Acid Defects and Hydrogen Ion Concentration in Brick Cheese. Walter V. Price and D. W. Spicer, University of Wisconsin.

The commercial value of Brick cheese is seriously reduced if graders can detect shortness in body or excessive acidity in the flavor. Flavor and body characteristics of approximately 70 lots of cheese were classified by the judges as sweet, slightly acid, sour and very sour. Measurements showed that the minimum pH was usually attained in 3 to 5 days after making. This minimum pH for each lot of cheese was closely related to the degree of acidity indicated by the criticism of the cheese judges. It was concluded that a minimum pH of 5.15 is excellent assurance that judges will not criticize Brick cheese for excessive acidity.

M47. Bound Water and its Relation to Dairy Products. H. PYENSON AND C. D. DAHLE, The Pennsylvania State College.

The cryoscopic method introduced by Newton and Gortner (Bot. Gaz. 74: 442, 1922) was used to determine the bound water content for this work. Determinations were made for acidity, alcohol stability, pH and viscosity. Following is a brief résumé of the results obtained:

The cryoscopic method can be readily used for the determination of bound water in liquid dairy products containing up to approximately 40 per cent solids.

Milk contains from 2.0 to 3.5 per cent of bound water, while buttermilk and skimmilk contain from 1.5 to 2.5 per cent of bound water. Cream contains about 0.15–0.19 gram of bound water per gram of solids. Colostrum milk containing 19 per cent total solids contains 4.65 per cent of bound water. The bound water of condensed milks vary with the total solids content.

It was found that milk containing 2.92 per cent of bound water after 24 hours aging at 40° F. has a distribution of its bound water content as follows: Casein 49.16 per cent, albumin 29.55 per cent, butterfat membrane 18.55 per cent, and serum minus albumin 2.74 per cent.

There is invariably an increase in bound water content upon aging at 40° F. In most cases along with this increase occurs an increase in the viscosity and protein stability. High heat treatment results in a decrease in bound water content, an increase in protein stability, and a decrease in viscosity. Short aging periods at relatively high temperatures give practically the same bound water content as longer aging periods at low temperatures.

Heat treatment above pasteurization temperatures decreases the bound water content of milk and dairy products. Even after aging at low temperature it never increases to the original unheated control.

Homogenization decreases the bound water content of ice cream mixes. As the pressure is increased there is an increase in the degree of fat clumping and a decrease in the protein stability and bound water present. Dual homogenization decreases the fat clumping, increases the bound water content and also increases the protein stability of the mix.

Increasing the pH toward neutrality and slight alkalinity decreases the bound water present. Decreasing the pH toward the isoelectric zone also

decreases the bound water content but to a greater degree than when the pH is increased.

The so-called milk protein stabilizing salts increase the bound water content and protein stability, while the destabilizing salts decrease the bound water content and protein stability.

The freezing of skimmilk causes an increase in the bound water content up to 85 days of storage at – 15° F. and then it gradually decreases in bound water. At 147 days the skimmilk appeared quite normal but watery. Frozen condensed skimmilk increases in bound water up to 25 days. At 57 days the proteins were partially cogulated so the bound water determination was not made.

The Hening and Dahlberg method of increasing the viscosity of sweet cream shows that when the cream is aged for 24 hours, an increase in the bound water content over ordinary pasteurized sweet cream results. Nevertheless, less bound water is found than in aged raw cream, although the viscosities were almost identical.

The fat globule membrane is hydrophilic in nature, binding about 0.6 gram of water per gram of solids. Pure milk phospholipids bind 6.0 grams of water per gram of phospholipid material. High pasteurization temperatures reduces the bound water content of the fat globule membrane and the milk phospholipids.

Creaming studies indicate that there is a decrease in cream volume and bound water content in whole milk when heated to high pasteurizing temperatures. Reconstituted milk made from heated 54 per cent cream and raw skimmilk gave a slight reduction in creaming and a reduction in bound water content while heated skimmilk mixed with raw cream gave a decided reduction in cream volume, and a normal reduction in bound water content.

Studies with raw and pasteurized milk made above and below the solidification point of the fat globules and with raw and pasteurized skimmilk indicate that the increase in specific gravity on standing (Rechnagel's phenomenon) is due partially to an increase in the hydration of the proteins and partially to the solidification of the fat globules and loss of carbon dioxide.

Gum arabic binds between 0.4 and 0.6 grams of water per gram of gum independent of the concentration and period of aging. Locust bean gum binds 1.93 grams of water and "Colace" 0.91 gram of water per gram of solids. Powdered egg yolk shows 0.92 gram of bound water per gram of egg yolk. Sodium alginate and gelatin give negative results.

M48. The Phosphatase Test for the Efficiency of Pasteurization. A. B. Storrs and L. H. Burgwald, Ohio State University.

Briefly, the basis of the phosphatase test is as follows: A small amount of milk is added to a substrate solution containing disodium phenyl phosphate and the mixture is incubated. The action of phosphatase, if present, upon this substrate results in the liberation of free phenol. The amount of phenol

liberated is then determined colorimetrically and serves as an estimate of the degree of heat destruction of the phosphatase, thereby indicating the efficiency of pasteurization.

In this investigation of the test the results obtained thus far indicate that the addition of as little as 0.2 per cent of raw milk to properly pasteurized milk, or underpasteurization by 1½–2° F., or a holding period of 20 minutes or less can be readily detected. It is possible that further modifications may improve the accuracy of the test in some respects.

The test has also been applied to milk pasteurized by the short-time high temperature method and although the data are not yet complete it appears that the test may be used quite satisfactorily on milk pasteurized by this method.

An investigation of the possible effects of mastitis milk on the accuracy of the test is also being carried on.

M49. The Significance of Ammonia in Milk: A Practical Method for Its Determination. A. E. PERKINS, Ohio Agricultural Exp. Station.

The ammonia content of milk has been a matter of interest and study for at least 80 years.

Formerly the ammonia found in milk was attributed mostly to contamination from the stable air or the chance introduction of impurities. It has since been shown, however, that even aseptically drawn fresh milk gives small but definite values for ammonia, averaging about .35 mg. per cent or 3.5 parts per million. These values are somewhat affected by the individuality and condition of the cow and possibly also by other factors. These points, however, have not been thoroughly studied.

By far the greatest source of ammonia in milk is the development of bacteria. The different species show marked differences in this respect and temperature plays an important rôle; but here again the subject has not been thoroughly studied.

Some of the methods which have been proposed for the determination of ammonia in milk are not reliable. Others which seem reliable make too great demands either in point of time or special equipment to permit their extensive use.

Proposed Method. 100 cc. of milk are placed in a flask with a graduation at 500 cc. 20 g. of dry or anhydrous $MgSO_4$ are added with shaking to assist in dissolving the salt. About 300 cc. of a good quality of 95 per cent alcohol are then added and the mixture thoroughly shaken. Alcohol is again added to the 500 cc. mark and the mixture is again well shaken. After standing for a few minutes the material is filtered through a paper filter.

200 cc. of the alcoholic filtrate as obtained above representing 40 cc. of milk are placed in a 500 cc. Kjeldahl flask with ½–1 g. Magnesium Oxide.

125–150 cc. of the solution are distilled over in the regular Kjeldahl nitrogen apparatus, the end of the condenser or adapter being immersed in a measured amount of N/140 sulphuric acid. The surplus acid is titrated with N/140 ammonia, using a very dilute and carefully neutralized solution of methyl red as indicator. The blank due to reagents is practically zero, and recovery of ammonia added to the milk is about 90–95 per cent. The distillation is accomplished in about 10 minutes and a single sample may be carried throughout the process in about ½ hour. Doubtless micro equipment could be used to advantage, if available. Vacuum distillation has been tried and makes practically no difference in the results.

M50. The Application of Ritter's Test for the Detection of Copper in Milk and Dairy Products. JULES TURGEON, V. C. STEBNITZ AND H. H. SOMMER, Department of Dairy Industry, University of Wisconsin.

Ritter's test for copper contamination in milk, as originally reported, did not prescribe definite concentrations or amounts of the reagents to be used. It has been shown that the strength or amounts of the a-naphthol or the p-amino-dimethyl-analine sulphate had no effect upon the speed with which the color developed but the strength and amount of H_2O_2 greatly affected the rate of color change. The length of time required for the blue color to appear was decreased as the concentration of the H_2O_2 was increased. With the Ritter's test it was possible to detect added copper in milk with a concentration as low as 0.1 part per million. In general the time required for the color to appear was inversely proportional to the amount of copper contamination. However, this test cannot be used on different milks for determining the amount of copper present because the length of time required for the color to appear was found to be influenced by such factors as the age of the milk, the length of time in which the copper had been in contact with the milk, and the acidity. The addition of ascorbic acid to the milk containing added copper greatly retarded or prevented the development of a positive Ritter's test.

The milk from individual cows responded differently to the test when known amounts of copper were added. It appears that the susceptibility of the milk to oxidized flavor development affects the rate of color formation. Milks which readily developed a tallowy flavor when small amounts of copper were added also developed a blue color more quickly when subjected to the Ritter test than those milks which were more stable to oxidized flavor development even with larger amounts of added copper.

It appears that this test may be used not only for detecting copper contamination in a milk plant, but also the susceptibility of the milk from individual cows toward oxidized flavor development.

EXTENSION SECTION

E1. Conducting Organized Dairy Cattle Breeding Programs through Bull Associations. R. G. CONNELLY, Virginia Polytechnic Institute.

Organizing dairy cattle breeding is understood to mean the systematic mating of dairy cattle according to a definite longtime plan that will enable one to identify, trace, and analyze various genetic characters evident in populations of related dairy cattle. Any dairy cattle breeding program that permits the cumulative assembling of genetic data pertaining to cattle related by descent may be regarded from the genetic standpoint as an organized dairy cattle breeding program.

Major emphasis has been placed upon the herd sire in most organized breeding programs, and concurrently the measurement of genetic performance has been largely in terms of the production records of the daughters. Most sires being proved at present are owned by individuals. If these proved sires are the important avenue of approach in breeding up better strains of cattle, then some attention must be given to the perpetuation of the service and the blood of proved sires in enough cattle over a sufficient number of generations to permit the proper analysis and evaluation of the genetic traits existing in the family strains. The magnitude of such an undertaking bespeaks the need for cooperative breeding methods.

In the last analysis bull proving and the search for brood cow families should serve as important steps to a more comprehensive breeding program involving many more cattle than are now under observation. There should not only be a program of discovery such as our proved sire and brood cow investigations seem to be; but there should also be promulgated breeding programs by which superior inheritance discovered in individuals might be purified and concentrated in many cattle through intelligent matings. How such a program of genetic utilization can be developed among practical dairymen who are only now learning of the economic possibilities of dairy cattle breeding is a complex problem not yet solved.

The long time required to assemble dependable genetic information for a breeding program; the economic risk involved in dairy cattle breeding; the whimsical instability of men's reactions to the revelations of nature; and the lack of sufficient facts as well as standard fact finding methods are impediments in any comprehensive dairy cattle breeding program. Individually, dairymen strive to learn the genetic constitution of their cattle, but the earliest success and most lasting benefits are likely to be reserved for those men who breed large numbers of cattle and are able to perpetuate the lives of bulls and cows until their genetic influences can be analyzed and evaluated. This suggests the need for cooperative action among dairymen.

Cooperative bull associations, if properly organized, are replete with possibilities for individual dairymen who are not situated to keep more than one bull or who lack facilities for following the several methods of breeding—inbreeding, line breeding, multiple breeding to proved sires, etc.—to verify the purity of the inheritance of certain desirable characters and to perpetuate those characters in future generations. Where bulls are owned jointly, and the dairymen are of kindred minds and interests, bulls may be exchanged and proved with a minimum of risk to the individual dairyman. More comprehensive proof can be obtained on a bull if he is used in several cooperating herds and also when meritoriously proved bulls are discovered, they can be rotated among the several cooperating herds to recoup losses that will result when unsatisfactory bulls are proved. Furthermore, the female lines of related cattle can be studied to better advantage, and the heritable traits that determine productive ability, body conformation, and other physical characters can be concentrated in a large number of cattle in the least possible time if several dairymen are united under a cooperative breeding program.

Dairy cattle breeding programs conducted through cooperative bull associations lend themselves to better supervision from the state extension dairy husbandman and more nearly justify the talent and time required in the administration of a long-time dairy breeding project in the extension program. Finally, the possibilities of success when breeding up dairy cattle are likely to be greater if dairymen will merge their cattle breeding interests into a single program and develop the program as a cooperative dairy bull association. The benefits that may be expected from the cooperative treatment of so large a venture as progressive longtime dairy cattle breeding societies demonstrated by the signal accomplishments of cooperative breeding societies in Denmark, Holland and other countries.

E2. Dairy Sire Exchange Lists. WARREN GIFFORD, University of Missouri.

Any changes in the levels of producing abilities and other economic characters inherited by dairy cattle to higher levels that are under man's control will be brought about primarily by the systems of mating adopted and practiced in the individual herds, counties, states and country as a whole. Any progress in the improvement of the cattle population made by adoption of the Agricultural Extension Program or other educational movements must finally be measured by the average performance record of each successive generation of cattle produced within the group or population affected by such a program.

Selection seems to be the most powerful weapon for securing immediate improvements. Any Extension Program that actually brings about the production of more offspring from dairy animals of desired producing abilities than from inferior animals is a commendable project.

Dairy Sire Exchange Lists, which lists sires for sale, trade, or lease, are adopted and maintained as regular Dairy Extension Projects in 15 states of the 32 reporting as aids to breeders in securing sires for this improvement program. In 9 of these states these lists which give the owners of sires for exchange description and performance records of individuals, and the production information on the immediate ancestors and terms of exchange such as price, et cetera, are state wide in scope. Seven states maintain County Wide lists for the various counties. Only 2 states report the listing of sires for sale from other states. All states maintaining this service send lists to their County Agents. Ten send them to Dairy Herd Improvement Association members or their testers. Two states send them to their breeder mailing list. Four states prepare these lists monthly, four semi-annually and one annually.

These sire exchange lists contain from 10 to 460 bulls and it was reported that a range of from 2 to 75 per cent, or an average of 33 per cent were exchanged.

Five states maintain county sire books and county sire exchanges. The county sire books contain complete information on all sires in the county and is used as a basis for exchange. The exchanges are supervised by a County Committee and the County Agent.

E3. Using D.H.I.A. Records in Conducting Dairy Cattle Breeding Programs. E. E. HEIZER, Ohio State University.

This paper presents a brief outline of the Dairy Herd Improvement Association Sire Program as approved by the American Dairy Science Association in 1936.

A discussion of the utilization and interpretation of records as an aid to the development of a constructive breeding program in D.H.I.A. herds is presented.A suggested procedure for use in herd analysis and a discussion of environmental and management factors of importance are included.

E5. A Feed Insurance Program with Trench Silos. V. L. GREGG, University of Arkansas.

Insurance of an adequate supply of cheap yet palatable feed is the backbone of a successful long-time dairy herd management program. Practically all other practices making up good herd management become bankrupt when the farm feed supply is cut short, forcing the herd owner to buy feeds, especially roughages, or sell part of the producing herd. Feed insurance when combined with other good farm and herd management practices is low cost production insurance to the dairyman.

Dependence upon regular pasture and feed crops supplemented by emergency pasture and feed crops has brought dairy herd bankruptcy to many dairymen in our state. This condition has been the result of widespread

droughts with resulting shortage of feed on the farm and high prices for purchased feeds. However, we should not condemn this system we have followed but we should supplement it with low cost stored feed for such years as we have experienced recently and will experience in the future.

These are the fundamental problems and conditions that commanded the attention of agricultural leaders in our state and in other states to adopt a campaign for the construction and use of the trench silo.

Although our trench silo campaign is young in Arkansas in comparison with those in some other states we have made rapid progress. Results indicate that the trench has an important place in dairy and livestock production. An expression from one county agent when asked if his trench silo demonstrators were satisfied with the results, best illustrates the response we are getting. He said his demonstrators were not merely "satisfied" but they were "wild" about the trench and were eager to tell all their neighbors and visitors about their results.

The campaign was started in our state by first locating about ten trench silos that had been built by farmers who read about the trench in farm papers and proceeded to build one with or without assistance from the county agent.

Winter feeding meetings were held at these trenches in 1935–36. These were district meetings where county agents brought leading dairy and livestock farmers to see the trench and learn construction, filling, and feeding methods. Printed subject matter was distributed at these meetings and newspaper stories were used as follow-up to draw attention to the new feed storage method.

Largely as a result of these district meetings fifty-six demonstrations in 26 new counties were established in 1936. The results were so conclusive and convincing for the man who visited one of the original demonstrations that little effort was needed to establish the demonstrations in new territory.

One of the main features of this campaign is to establish demonstrations where farmers can see them easily and then make every effort to draw attention to the demonstration. The results in one county bear out the objective of this approach. In 1934 one trench was constructed and used by the farmer but no particular attention was drawn to it, mainly because the county agent had another program which demanded all of his time. However, there were seven new trenches constructed by other farmers who happened to hear about it. Publicity on trench silos in general aroused their curiosity and they talked about them and after hearing about this one they visited it.

The county agent in this county started an active campaign in the fall of 1936 by holding feeding meetings at six of the eight demonstrations followed by local publicity on the features of the trench. During the following February another series of meetings was held to show results of the silos

and to discuss crops to plant for ensilage, construction, and methods of filling.

These meetings were followed by more publicity on the same subjects as were discussed at the meetings.

A county committee was then selected to map out a campaign procedure. The committee selected community captains to make a special study of the trench silo and its logical place on a dairy or livestock farm. Farm organizations, civic clubs, and creameries were also contacted to solicit their general support and assistance in the selection of captains.

These committeemen and captains have already reported 200 farmers who have definitely made plans to have a trench silo this fall. Most of them are planting a special ensilage crop (Atlas Sargo and sweet sorghums are preferred) and some are already digging their trench during time they cannot work with their crops and while the soil is more easily moved than it will be in late summer.

At least fifteen counties are carrying out a similar campaign and thirty-five others are carrying it on in a modified form, some just getting their first demonstrations this coming fall.

The use of the trench silo is being projected through all meetings and much of the publicity related to feed production, dairy and livestock feeding and management, pasture management, and the soil conservation program.

The place of the trench silo in feed production to provide safe low cost storage with feed insurance when a reserve is built up is very obvious. Also the economy and efficiency of ensilage as a feed is an old story with all of us. But to some, the place of the trench in a pasture development and soil conservation program may be a new departure.

One of the fundamental necessities for pasture development on most farms is controlled grazing. Ensilage on hand at all times makes controlled grazing possible. The project managers of our soil conservation service areas have recognized this point and are urging their cooperating farmers to build up a reserve supply of ensilage to be used to protect their labor and cash investment used in establishing pastures.

The trench silo has a place in the soil conservation if used as a means of supplying sufficient stored feed from half the acreage normally devoted to soil depleting feed crops. Also as previously illustrated, the trench silo makes it possible for farmers to establish pastures and maintain a fixed number of dairy cattle or other livestock instead of merely establishing pastures for the purpose of receiving diversion or soil conserving payments.

These are some of the points that are being presented to avoid any misconception that the trench silo is a passing fad or is only to be used in years of drought.

New methods, new farm and herd applications, and new soil type and drainage ideas gathered from the field demonstrations are being widely

broadcast. For example, we have found that the size may be small enough for four animal units including work animals, the ensilage crop need not be chopped at filling time, drainage is not necessary, flood waters or seepage cause very little damage and soil type or texture has little effect.

Thus far in our campaign we have found that to show a farmer a trench silo is only the first step in its establishment and proper use. Seeing is convincing but in this case too often only that feed will keep in the ground is the only lasting impression made and its full application to his own problems is overlooked. The feed insurance feature and its effect on the establishment of a permanent system of dairy and livestock development that will not go bankrupt in unfavorable seasons is to me the goal for us in trench silo work.

This all means considerable work in a campaign way to get immediate results and it necessitates follow-up work to show the farmer the value of having a one or more year's supply of feed stored to protect both his dairy herd and his established cropping system thus insuring more security of farm income.

E6. An Extension Program in Dairy Cattle Feeding and Feed Crop Production. K. L. TURK AND W T. CRANDALL, Cornell University.

Dairying predominates in the agriculture of the northeastern states, first, because most farmers can grow to the best advantage, pasture, hay, silage, and other forage crops for which there is regularly no satisfactory cash market; and second, because of the availability of metropolitan markets for milk.

Dairy farm profits depend largely on high yields of good quality feeds and the marketing of these feeds through good cows that are fully fed. Economical milk production, therefore, is concerned not alone with feeding sufficient amounts of the right kind of nutrients to good cows, but with furnishing as many as possible of these nutrients in home-grown roughages. A relatively small percentage of the land is adapted to grain crop production, therefore, much of the grain fed must be purchased.

Our program in New York has been built around these facts, and the fact that cows are underfed, particularly during the pasture season, and full use of roughage is not being made. Once the dairy farmer appreciates these facts, and most of them do when it is called to their attention, he will be interested in details of growing more and better quality roughage and in getting more total nutrients into his cows. Not only does it mean higher production per cow, but much of it comes from that roughage produced on his farm. Once the farmer is sold on the need for a change in feeding and feed crop production practices then the rest is easy.

In carrying out an educational program emphasizing a fuller use of roughage in supplying nutrients for milk production, it is obvious that a

close relationship with Agronomy must exist. The two departments are cooperating very closely in all phases of this program in New York.

Plan of Program. Since the old method of holding a feeding meeting here and there is not effective in reaching a very large number of dairymen, a more comprehensive program was inaugurated on a campaign basis in 1935. The following outline gives a brief description of teaching plan followed:

1. *Training school for county agents.*

   Counties are selected on the basis of submitted Farm Bureau work programs that list feeding as a major problem in the county. County agents from each of these counties come into the college once each year for a two-day training school. The agents have a definite part in planning details of the program and teaching methods to be followed.

2. *Farm surveys*

   To check up on feeding practices being followed, township or district surveys are made. Later surveys will show any changes in feeding practices.

3. *Service letters*

   In order to reach a larger number of farmers and to furnish timely information that cannot be given in meetings, printed service letters have been effectively used in this program. These service letters are prepared by Animal Husbandry and Agronomy specialists. Dairymen in the counties are given a chance to sign up for these letters which are mailed to them each month.

4. *Two-day feeding schools*

   A two-day feeding school is held in each county. Also, several counties have held two-day Agronomy schools. In counties that have held both types of schools, combination Agronomy and feeding schools are held. Follow-up regional and county discussion type meetings are very valuable following the county-wide meetings.

5. *Demonstration farms*

   Demonstrational dairy farms are established in cooperating counties on which recommended practices of feeding and of feed crop production will be followed. These practices will show the relationship between efficient production of high quality feeds and farm returns from good cows well fed and managed. Farms selected are those that have possibilities for forage crop and pasture production which are not being fully used at present. However, these farms have herds that are free from disease, have inherited ability for high production and are being tested in D. H. I. Associations. Each farm is visited by Agronomy and Animal Husbandry specialists at least twice a year to collect records and make recommendations.

6. *Publicity*

Timely news articles on feeding for Farm Bureau News and county and local press are furnished the county agents at regular intervals.

7. *Analysis of D. H. I. A. records from feeding standpoint*

An analysis of feed records of members of dairy herd improvement associations is made each year. Many of the associations hold yearly summary meetings where their feeding records are discussed.

8. *Dairy tours—field days*

Dairy tours are held in each of the cooperating counties. In the future these tours will feature the demonstration farms.

9. *Exhibits*

Feeding exhibits are arranged at county fairs and also at the state fair.

Through all these teaching methods a few simple practices are continually stressed. As they apply these feeding practices, more dairymen will develop the resources of their farms for the greatest economical production of nutrients. This will reduce their dependence on purchased nutrients in grain and they can realize the greatest possible returns on the home-grown feeds by selling (feeding) them to good cows of high producing ability.

E7. Establishing and Conducting a Dairy Pasture Improvement Program in Missouri. M. J. REGAN, University of Missouri.

The pasture problem in Missouri presented itself as a State wide problem of making Missouri dairymen pasture conscious. In attempting to work out a Dairy Pasture Program it became evident that there were three distinct phases, that of establishing a pasture program, preparing the necessary equipment and conducting the program in the field.

Establishing the Program. In establishing the Dairy Pasture Program it was necessary to determine the need for such a program in order to know the size and scope of the problem. It was determined in Missouri that approximately 40 per cent of the land is in pasture and that less than 1 per cent of attention paid to this important problem. This land, for the most part, is sub-marginal and to some extent is land that has become unprofitable for cultivated crops. Our second problem was to set up the needs within the program such as seasonal pasture and land fertility requirements. A good soils system and a poor soils system of farming was established. The supply of natural pasture by seasons was determined and seasonal supplementary pasture recommendations worked out. It was also necessary to bring out the economic importance of the problem and the amount of work accomplished up to date. This included slope of the land, soil losses, fertility

losses, water holding capacity of soil and their relationship to the time the land is covered. Showing in addition the labor saved and the economy and efficiency of production. At attempt was then made to set up an all inclusive State wide system.

The State wide program was then given a name or slogan that would attract attention and invite criticism. This was first given the name of the "Year-Round Dairy Pasture Program," and was later changed to the "All-Year Pasture System." Close cooperation has been maintained with the Soils and Crops Department. Through the help of this Department the system of single field rotations was worked out, gradually the Crops Department took over the entire responsibility for pasture development in Missouri.

Equipment Needed. After successfully demonstrating individual pasture practices it became apparent that the entire system needed to be presented to the field. Charts, circular letters, news articles, method and result demonstration blanks, bulletins, circulars, radio talks and exhibit material were developed to fill this need.

Conducting the Program in the Field. In taking the program to the field result demonstrations were established to show, by example, the practical application of this system and to prove to the community that this system is in no sense experimental. The establishment of these demonstrations allow the Extension worker to utilize the result secured to prove, by comparison, the value of this system. It was then recommended that the County Extension Agents adopt this as a project in their Program of Work. Community meetings were held and all of the publicity methods above mentioned were utilized. A gradual attempt is now being made to move from individual pasture systems to a pasture consciousness, feeling that progress will tend to bring sub-marginal lands into the marginal class, increase the average number of animal units carried on the farm from eleven to at least twenty, reduce cost and increase the efficiency of meat and milk production and move toward a less rigid, a freer and more abundant farm life.

E8. A new Method of Conducting a Feed Meeting. J. G. HAYS, Michigan State College.

A new method of discussing the problem of low-cost feeding has been successfully used in Michigan.

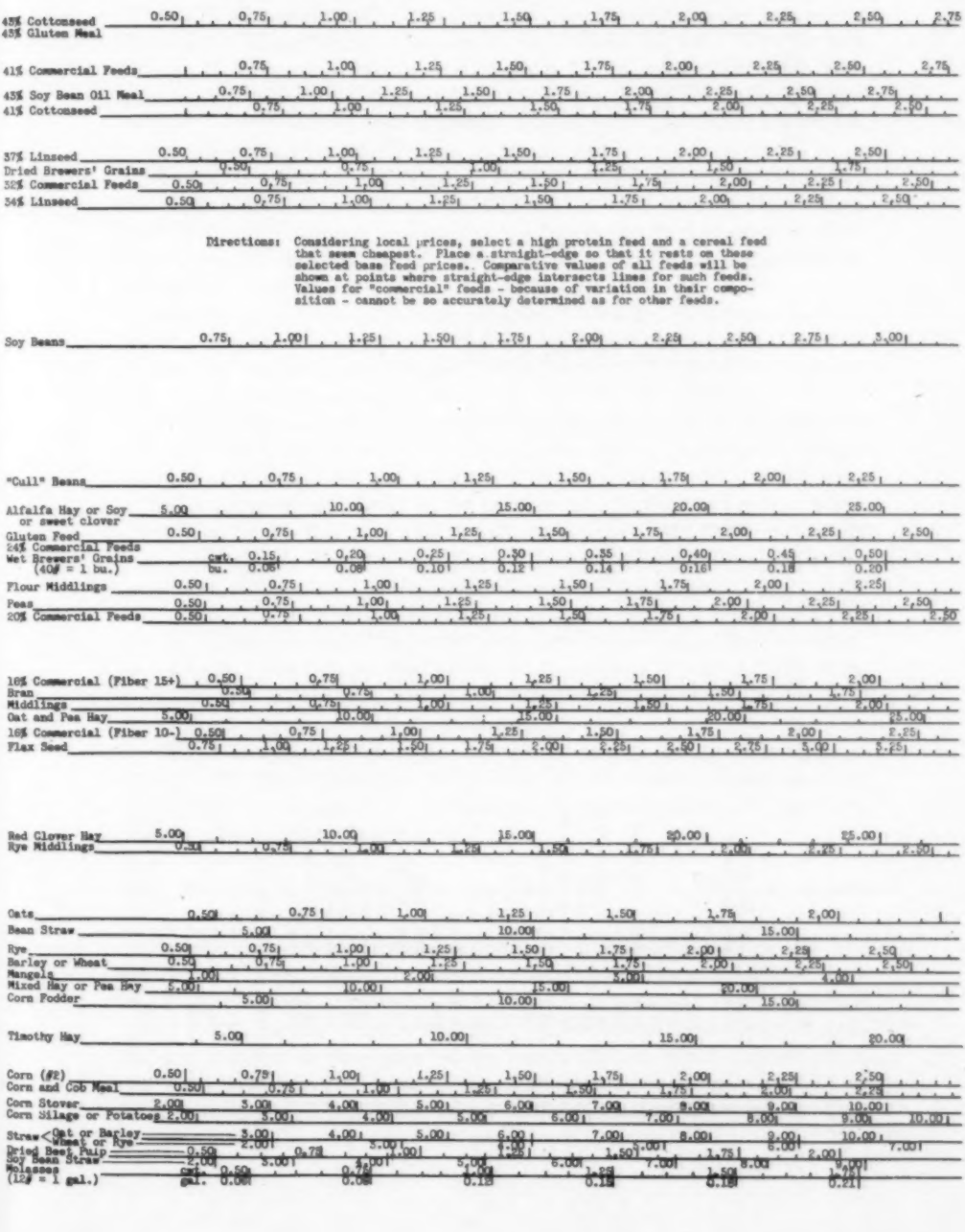
The method is new in that a slated (or "blackboard") flexible chart is used, on which local feed prices are chalked in; a feeding value for each feed is assigned through the use of a new table called "Evaluation of Dairy Cattle Feeds"; and comparison of feeding value with local price for each feed shows whether such feed is too costly, worth the money, or a bargain.

Interest on the part of the crowd is easily sustained because this method of presentation employs the value of suspense and of surprise.

EVALUATION OF DAIRY CATTLE FEEDS

Michigan State College Dairy Extension (1927)

Feed values for roughages are by the ton; all other feeds by the hundredweight.



Directions: Considering local prices, select a high protein feed and a cereal feed that seem cheapest. Place a straight-edge so that it rests on these selected base feed prices. Comparative values of all feeds will be shown at points where straight-edge intersects lines for such feeds. Values for "commercial" feeds - because of variation in their composition - cannot be so accurately determined as for other feeds.

Feeding values

D.P.	NON D.P.		$ PER CWT.	LOCAL PRICE	¢ SAVE	D.P.	NON D.P.		$ PER TON	LOCAL PRICE	$ SAVE
7	73+	Corn No. 2)				10+	31	Alfalfa Hay			
6	70	Corn and Cob				10+	31	Sw. Cly. "			
9+	62	Oats				11	31	Soy Bean "			
10	70	Rye				9	36	Pea-Oat "			
9+	69+	Barley				7	36	Red Clv. "			
11	72+	Wheat				4	34	Mixed "			
35+	40+	43% Cottonseed				3	32	Timothy "			
34	39+	41% "				3+	32	Corn Fodder			
36	45	43% Soy Bean O.M.				2	22	Corn Stover			
33	54	Soy Beans				3	20	Bean Pods			
36+	45+	41–43% Gluten Meal				1	20	Oat-Straw-Barley			
33+	44+	37% Linseed				1	10	Wheat-Straw-Rye			
30+	47+	34% "				1	12	Corn Silage }			
22+	54+	Gluten Feed						Potatoes }			
21+	87+	Flaxseed						Roots }			
20+	30	Dd. Brewer's Grains				3+	12	Alfalfa Silage			
20	55+	Beans									
20	59+	Peas									
13	57	Rye Midds									
15	60	Flour Midds									
14+	57+	Std. Midds									
13	53+	Std. Bran									
5	67	Dd. Beet Pulp									
4+	11	Wet Brewer's Grains									
1	55+	Cane Molasses									
2+	56+	Beet									
(Estimated)		Commercial Mixed									
35	45	41%									
30	45	32%									
21	55	24%									
18	55	20%									
14	55	16% (Fiber 10% –)									
15	50	16% (Fiber 15% +)									

The chart. For ease in transportation the chart is made of slated cloth. (Size 52 × 60 inches.) The data shown below are permanently painted on the chart. Values for digestible protein throughout are taken from the new edition of Morrison's "Feeds and Feeding." Values for digestible non-protein follow Morrison excepting for roughages and for concentrates high in fiber. Here values follow Huffman of Michigan. All values are quoted to the nearest half pound, the mark + indicating five tenths.

The table "Evaluation of Dairy Cattle Feeds" was worked out after the method devised by Petersen of Minnesota. With a known price for a local feed high in protein and for one low in protein, the comparative feeding values for all feeds on the table can be quickly found, expressed in dollars and cents.

Meeting procedure. The most effective use of the chart is to have the column headed "Local Price" filled in before meeting starts. Reliable figures can best be obtained from a feed-dealer or D.H.I.A. tester. (Farmers' figures vary, depending on when and where they purchased.)

Next taking each feed in turn discuss its make-up from the columns headed "D.P." and "Non D.P."; point out any special properties as palatability, laxativeness, local availability, and finally from the table "Evaluation of Dairy Cattle Feeds" chalk in the feeding value in column headed "$ Per Cwt" (or "$ per Ton"). This figure is what the crowd has been waiting for. Its appearance settles whether the local price on the feed under discussion rates the feed as costly, worth the money, or a bargain.

Throughout the meeting constant stress is laid on the point that no feed can be correctly evaluated unless it forms part of a properly balanced ration. Warning is given that no feed should be introduced into a ration just because the feed is locally low priced; the feed must fit into the feeding system. Systems of feeding are therefore discussed.

Which combination of roughages and of grains will produce milk at lowest cost? Each farmer is provided with two documents to help him easily figure this out for himself—a sheet showing balanced rations, and the sheet, "Evaluation of Dairy Cattle Feeds."

E9. Subsidizing Testing from the State Office. J. W. Linn, Kansas State College.

Unlike some other countries, in the United States the organization and financing of dairy herd improvement associations has been considered to be the local dairymen's problem. The adoption of rules and regulations laid down by the Bureau of Dairy Industry, United States Department of Agriculture, has been at the option of the various states. Within recent years, the states have almost universally accepted this uniform program.

The financing of dairy herd improvement associations has been one of the major problems in their organization and maintenance.

The facts presented in this paper are the result of a questionnaire sent out to every state in the union for the purpose of studying this problem. Forty-one replies were secured, eight of which indicated some central office financial assistance to dairy herd improvement associations. Two of these might be considered as subsidization, the other six more as payment for extra service on the part of the tester.

Not until 1923, when the state of West Virginia began paying twenty dollars a month from the state appropriated funds, was any effort made to assist the local dairymen in the problem of financing their association. The policy of paying supplemental money to testers is now in effect in five other states. In every case, the money given is for additional services rendered.

In Kansas and Mississippi the testers are listed as assistant county agents in order to be eligible for these funds. When the Kansas Extension Service's federal funds are audited, it is possible for the auditor to tell where every cent has been used and the financial relationship of every association member.

Some of the advantages secured by furnishing financial assistance to the dairy herd improvement association may be summarized as follows:

1. Added service, such as assisting with farm management work, is made possible.
2. Better testers can be secured.
3. Tester is definitely linked with Extension Service.

Some of the disadvantages to this program are:

1. More work is added to the already heavy schedule for testers.
2. The added work is forcing a change in methods of keeping feed records on individual cows.
3. Adds work at the State Extension office.

Extension Services have taken a definite step forward in assisting with the financing of dairy herd improvement associations. The program has been improved by the addition of other services, securing better testers, and making the plan a part of the Extension program. The plan will be more permanent where a definte financial accounting system is used.

E10. Subject Matter Included in Testers' Training Courses. FLOYD J. ARNOLD, *Iowa* State College, Ames.

The knowledge which cow testers must have in order to develop all phases of Dairy Herd Improvement Association work, makes specially designed training courses necessary. In addition to knowing the daily routine of keeping accurate production and feed records, the properly trained tester, is familiar with uniform rules and regulations governing D.H.I.A. work; understands the National plan for "Herd Identification and the recording of Production records"; is able to analyze records to show influence of sires or foundation cows, etc. In most states, Herd Improvement Registry test-

ing is handled through the Dairy Herd Improvement Association and to do this work the tester must be familiar with the breed rules.

The need for testers to fill vacancies is unusually large due principally to the nature of the work. Many testers because of their education and training have opportunity to step into jobs which pay a higher salary and are more desirable. During 1935 and 1936 in Iowa a total of 50 inexperienced testers were placed. These men were all high school graduates and half of them (25) had college or short course training.

To determine the amount and kind of training required of testers in different states a questionnaire was sent to all Dairy Herd Improvement Association supervisors. The information received on these questionnaires indicates that the amount of training testers get varies from nothing but instruction in handling the records to a three months' course in College. To a large extent training courses are taught by Extension Dairymen.

Some of the topics included in Testers' Training Courses are:

(1) A general summary of Dairy Herd Improvement Association Work.
(2) Steps in Organization and Reorganization of Associations
(3) Importance of Uniform Rules and Regulations
(4) Procedure in Compiling Herd Record Books
(5) Summarizing the Herd and Association Records
(6) Sire Improvement Program
(7) Recording the Identity and Production Performance Permanently
(8) Compiling Permanent Herd Records
(9) Herd Improvement Registry Testing
(10) Association Activities

The method of training testers should include actual practice. The use of information and technique rather than merely giving subject-matter courses to familiarize testers with organization and state set-up.

E11. Getting Permanent Records Filled Out for Dairy Herd Improvement Association Members. C. R. GEARHART, Pennsylvania State College.

Permanent records as used in this topic refer to records kept on a special sheet designated an BDI–1057 which was made available through the Bureau of Dairying, Washington, D. C., in 1936. This special record sheet is often referred to as the Life History Sheet of a cow.

For years Dairy Herd Improvement Association records have been compiled by testers and recorded in the members' herd books. The detailed information kept in these books together with the totals and summary at the end of the year are essential in a good dairy herd record keeping program. In most herds, however, the herd book for each calendar or association year provide the only permanent record of the production, reproduction and other data on each cow in the herd. Many dairymen have continuous records

on their herds over a long period of years. This means that the records of each individual cow are in as many herd books as the number of years the cow was on test. The complete record of a cow in the milking herd for 10 years can only be found through a study of 10 herd books. This takes time and is inconvenient and as a result the lifetime records and history of an individual cow are seldom known. Lifetime records are very important however, in a constructive herd improvement program.

The permanent record, or life history sheet as it is called, is designed to show the lifetime performance of a cow on a single sheet.

The value and wide useful application of the information on the life history sheet is beyond the average testers' and dairymens' vision. Some of the uses to which the sheet can be put are:

I. It makes it possible to examine the lifetime performance of a cow without looking through a number of herd books, forgetting what was in the first books as you hunt for the record in the last books.

II. The daughter's records can be compared with those of her dam by simply bringing together the two life history sheets.

III. The records of dams and daughters at various ages can be compared, such as the two-year-old record of the dam and the two-year-old record of her daughter.

IV. To study the result of the use of various sires in the herd the life history sheets of all daughters of each sire can be sorted out and brought together in groups. This makes sire comparison an easier matter.

V. The influence of foundation cows in the herd can be studied by bringing together the records of such cows and their progeny through the several generations. Often such a study reveals foundation cows whose superior type and production qualities have persisted through several generations.

VI. The sheets provide an easy way of getting information for sales, for pedigrees and for proving sires.

VII. A glance at the life history sheet of an animal will show her lifetime breeding history.

The discussion at the American Dairy Science meeting will center around method involved and the success and difficulties encountered in getting the life history sheets made out and kept up to date as disclosed by replies to a questionnaire which has been submitted to the various states.

E12. What Can Be Eliminated from the Tester's Work To Make Possible Newer Developments. A. B. NYSTROM, Bureau of Dairy Industry, U. S. Department of Agriculture.

The work of a tester is sure to change from year to year as the interests of the members change and as the tester himself sees the need for taking on new tasks. Within recent years the various extension workers, particularly county agents and State extension dairymen, have likewise demanded extra

work of the testers, all of which is aimed at more effective results from D.H.I.A. work to the ultimate benefiit to the producer or member of such associations.

Just how much work a tester can do is largely a matter of individual ability. Differences in testers are as inevitable as differences in other classes of workers. Therefore, if nothing is said about his duties the tester will make his own decisions as to what to eliminate, to the possible detriment of the ultimate result of the whole project. What the tester needs and would welcome is some sound advice from his county agent and the State extension dairyman as to what could be eliminated; and in order that these advisers may give sound counsel, it was thought desirable to discuss the matter thoroughly before the Extension Section of the American Dairy Science Association, and to broadcast the results of these deliberations among those interested.

In order to get an expression from all of the States on this topic, the writer made a survey by means of a questionnaire that included a list of 16 duties which might be considered for elimination. Included in the questionnaire was a request that other duties not in the list be added where possible.

A few of the duties included in the questionnaire were: Weigh and record the roughage fed to each cow each visit; same for concentrates; report individual feed records on each cow each visit; report daughter-dam comparisons on BDIM–672; test samples of skim milk for herd owners; make outline of markings of each animal on test; fill out BDI–46 for each cow; fill out BDI–46 for herd totals only; and fill out Life History sheets (BDI–1057–58) for all animals tested.

The final results of the survey were to be presented in full at the June Meeting at Lincoln. An attempt was to be made to show clearly which of the testers' duties must be continued if the tabulations made by the State and by the Bureau of Dairy Industry are to continue; likewise which may safely be dropped without impairing the effectiveness of the work.

That there is considerable interest in this subject is shown by the fact that up to April 26 replies had been received from 35 or nearly 77 per cent of the 46 States queried. In nearly every case also, comments were received by letter and some very pertinent suggestions were included. Replies received up to April 26 indicated that some of the duties listed were clearly voted out, while others could be eliminated in some States, but not in all.

E13. Uniform Rules Governing the Operation of Dairy Herd Improvement Association. FLOYD JOHNSTON, Iowa State College.

Dairy Herd-Improvement Association testing in the United States is again growing rapidly and should continue. Although the more important value of association records is a guide to the dairyman himself, more and more emphasis is being placed on the advertising value. It will probably

continue that way. Publicity given records will keep many dairymen from testing because of the inherent desire to keep from their neighbors information about their cows.

With the widespread recognition and general acceptance of the identification and permanent record program it seems obvious that rules governing dairy herd-improvement association testing should be strengthened to insure public confidence. Such rules must be lenient enough to encourage more testing and be practical enough to be administered. Any regulations formulated should, (1) insure accuracy, (2) be enforceable, and (3) not discourage testing.

It is simple enough to set up rules that will fullfil the first requirement, but not so with the second and third.

Some of the people interested in records would like the rules governing dairy herd-improvement associations as strict, if not even more so, than the rules now governing the breed herd tests. Others seem to want essentially no rules at all. There must be a "middle course" that will insure reliability and yet that can be enforced.

To determine the desire of the states concerned a questionnaire with tentative rules was submitted to all state supervisors of dairy herd-improvement associations, superintendents of testing of the breed associations and officials at Washington, D. C. A set of regulations will be prepared from a summary of questionnaires returned. They will be submitted for consideration at the Extension Section meeting in June at Lincoln.

E14. Dairy Herd Improvement Association Publicity. E. C. SCHEIDENHELM, Michigan State College.

The problem of carrying on a publicity program for dairy herd improvement association work has always been one that provoked considerable discussion by dairy extension men. It has been known that it is desirable to have an effective publicity program. Just how this program should be handled and developed is the question again at hand. To approach the problem is seemed advisable to divide the discussion into two separate divisions. The first dealing with publicity as it is developed locally in the county or association area, and the second from the standpoint of the dairy extension office on a state wide basis.

It is generally recognized that publicity in the county or local area can be divided into two divisions, one dealing with records, and the other with desirable dairy practices. Dissemination of publicity material from the central dairy extension office is one that can be confined largely to informing the testers, county agents, and members of the progress of the work.

To get a picture of the attitude on this problem from a national viewpoint, questionnaires were sent to all the state dairy extension offices. At the time of this writing statistics are available from twenty-seven states, of which

twenty-six gave replies. One state has only a few herds on test and consequently is doing very little in a publicity way. The twenty-six states reported included 78.6 per cent of all the associations operating in the United States on January 1, 1937.

Publicity within the county is probably the most effective from the standpoint of keeping up the interest in each association. People naturally like to hear about people and practices that are close to them or those whom they know. Twenty-five of the twenty-six states reported encourage local publicity. It is interesting to note that in Wisconsin the state office does not encourage local publicity. This is left to judgment of the county agents in counties in which the associations operate.

In the mind of the author more of the publicity within the association area should be devoted to desirable dairy practices used and the influence they have than to the use of large numbers of high cow and high herd information. Results from the use of desirable practices can be expressed in increased returns in dollars. After all, we are trying to improve the farm income of our dairymen. We know that herds of a certain level of production are more profitable than those below this level. However, I believe many agree that if we can talk more about increased returns than about high production we can accomplish more good by doing so. Five states of the twenty-six already limit publicity to practices only. Many more say this should be done.

Apparently a majority of the states are attempting to get some type of report on association activity back to the members monthly. Only two states out of the twenty-six reported do not send back to the members a summary of the yearly report to at least a majority of their associations.

Abut sixty per cent of the states discourage high cow publicity. Idaho has a method which could be adopted profitably by other states. This is called the "high-low" cow publicity. The purpose is to encourage a uniformity in the cows' production in a herd, rather than a few extremely high cows, some of medium production and others quite low from a production standpoint, all are of a more uniform production level.

Whether publishing feed cost information gives the public the wrong impression as to total production costs received about a fifty-fifty vote, with a slight edge in favor of those saying that it does.

There is an indication that many states are definitely turning to more publicity on lifetime records on cows. Many states not doing so at the present time say it is a good idea. No doubt with the permanent herd books coming into use this type of publicity will be used quite extensively in many states in the future. It will be a turn in the right direction.

The question of how publicity should be handled from the state office is one largely resolving itself into how many channels are available and which of those available are most effective. All but one state reported issues a

state summary each month. Pennsylvania does not, however one will find that this state held up on association numbers as well or better than any other during the depression years. This state sets up a seasonal publicity campaign through the testers on desirable practices. This again raises the question, is it not more desirable to encourage profitable practices. After surveying many of the monthly newsletters published in the various states one finds a great wealth of information dealing with practices. Possibly it would be just as well to confine the monthly newsletter largely to this material. Michigan does this to a large degree, state association information is summarized by districts with no mention made as to association names, herd owner's name, or name of owner of high cows.

With reference to the "latitude and longitude" of the persons reached through the state newsletters one finds considerable variation. Policies set up by state extension directors and the amounts of funds available for this material are probably two factors playing an important role. Only ten of the twenty-six states include Smith-Hughes instructors of their D. H. I. A. newsletter list. Probably many of us are missing a splendid opportunity to inform many "future farmers" about the value of the D. H. I. A. program.

In most states the important dailies, weekly or monthly farm magazines are used to publish stories on D. H. I. A. activities. Probably another good avenue for this publicity would be through the "house organ" of many of our cooperative creameries and cooperative milk associations. Many of the members of these organizations should be good D. H. I. A. prospects.

E15. Methods of Financing 4-H Dairy Calf Club Members. JAS. W. LINN, Kansas State College.

Extension dairymen realize that of all the 4-H Club projects, the dairy calf club is the most difficult to finance. The reason for this is that: First, purebred dairy calves cost more than other club animals; second, the project covers a three-year period; third, the returns necessary for retirement of the original investment cannot be obtained before the third year; and fourth, the risk is greater because of the cost and length of the project, and the fact that usually only one animal is involved.

The problem of finance is easily cared for when the club member has sufficient means or when a calf can be secured from the parent's herd. In most cases, however, the calf must be purchased, and in many cases the financing must also be arranged outside the home.

To become familiar with the methods used throughout the United States a questionnaire was sent to every state. Reports from 19 of the states indicate that finances from the home and local bank have been adequate to meet the need, while the 19 other states report one or more additional methods of financing club members have been used. Besides being financed at home or by the local bank, the other three principal methods are: First, civic clubs,

chambers of commerce, or members of these organizations; second, National Production Credit Associations; and third, breeders selling on a note or contract. Also in some states money is furnished by state breed associations, farm bureaus, state dairymen's associations, and a junior breeders' fund.

Because of the comparatively large financial risk, it is essential that some type of insurance be carried wherever money has been borrowed. This might be carried either cooperatively or from some insurance company.

Three states recommend that other projects with a quicker cash return be carried with the dairy project to assist in paying for the calf. Two states recommend the use of one-half the milk or cream check for the retirement of the note. Two states suggest the purchasing of bred yearlings in order that some return may be secured during the first year. Three states recommend a definite schedule of payments.

Since proper financing and insuring are fundamental in any program, further study should be made and reported to this group.

E16. Applying the Danish System of Judging to Dairy 4-H Club Work. D. M. Seath, Kansas State College, and G. M. Harris, University of Kentucky.

Before deciding upon how well the Danish plan would serve American 4-H Dairy Club shows one should first consider some of the features of the Danish system. As practiced in Denmark in the open classifications, the system includes some of the following distinctive features:

1. Each Danish herd is entitled to show in its own district only. Prior to the district show, however, it can be shown at its local show. Because of this limitation there is no show circuit arrangement.

2. Every animal coming to the show is classified. The entries in the class are first lined up individually then the class is usually divided into four (sometimes five) groups and distinctive display cards are awarded to the owners who must display them above their animals at the fair.

3. To make the final cash awards consideration is given in some shows to the pedigree of the animal which includes the show ring and lifetime production records of its ancestors. The universal adoption of the Danish plan for placing 4-H Club calves in the United States would have the following advantages.

1. The classification feature would help avoid many hair-splitting decisions and would help prevent certain reversals of placings at later fairs.

2. It would help establish more definite ideas pertaining to grades of perfection in dairy 4-H Club work. It could serve in this connection with type alone, or if also applied to ancestry records, etc., it could do likewise for pedigree judging.

3. The system could make it easier to handle large classes, and would send each club member home with a more definite idea of the relative merits of his exhibit.

4. It would reduce the glory going to the top place winner and let others falling into the first group share some of it.

5. Judges could omit awarding first group awards where quality is poor or reduce its size to show relative merits of exhibits.

6. A more equitable distribution of money could be effected with prize money more nearly serving its true purpose; namely, paying the necessary expenses of getting animals to and from the show.

In spite of the many possible advantages that might accrue from the adoption of the system there would likewise be certain difficulties encountered. Among them are:

1. The plan would not be too adaptive to small club shows. With small classes it would be hard to find representative classification groups.

2. One of the most serious problems would be to keep uniform grades in the minds of the public. Judges would vary in their ideas, and it would require frequent judging conferences to keep their classifications consistent.

3. More ribbons would be required, thus making the plan slightly more expensive than our present one.

4. Our conventional type of show has contributed much toward our 4-H Dairy program and many will hesitate to support a change.

Reports from state 4-H Club leaders and certain dairy specialists indicate that many are ready for the adoption of some such plan as the Danish one in the placing of livestock exhibits. In fact State 4-H leaders have already adopted some such classification plan for all of the exhibits except livestock at the International Livestock Exposition where they hold their national 4-H Club congress annually.

Livestock shows have already, at various places, used this system of placing their animals. At least one State 4-H Club show used it during 1936. Various states have tried it in connection with their spring parish shows. The Wisconsin Dairymen's Association sponsored a group of dairy shows in 1936 where this system was used exclusively. In all these cases, and many more that will be reported upon at the Association meeting, the system has been found to be satisfactory on a whole. Most objections found have been listed above. In most cases with slight changes these have been or can be altered in order to give more satisfactory results.

E17. 4-H Club Demonstrations for Improvement of Quality. E. A. GAUNTT, New Jersey College of Agriculture.

In New Jersey the dairy farmer is faced with high taxes, high labor costs, high land values as well as high feed costs. In order to stay in the dairy business it is necessary for him to produce only the highest quality of milk possible. Although the New Jersey State and local Boards of Health requirements are high it is necessary for the New Jersey farmer to more than meet the requirements if he is to keep his rightful place in the metropolitan New York and Philadelphia markets.

The extension service long ago realized that it had a job to do. 4-H club work seemed to offer one of the best opportunities to further this program of helping the farmer to produce a high quality milk. Demonstration teams were organized and trained to show how clean milk is produced. These appeared before Granges and other farm groups. Then a film strip was made up by J. B. Parker of the U.S.D.A. with the aid of one of the extension dairymen in New Jersey.

This film strip outlines the value of milk to the human race and the procedure in setting up a quality milk club. In this club the members are taught how to wash and sterilize utensils and how to clip udders and flanks. They are taught the use of the strip cup, proper cooling and methods of testing the quality of milk. They score dairy barns, and learn how milk should be handled from the time it leaves the cow until it reaches the consumer.

This educational method has helped tremendously in improving the quality of milk produced not only in the herds where there are 4-H club members but in many herds throughout the state.

E18. A Quality Improvement Project for Milk and Cream. C. J. Babcock, Bureau of Dairy Industry.

The quality of a dairy product depends primarily upon the quality of the raw product from which it is made. To improve the quality of dairy products it therefore becomes necessary to improve the quality of the milk and cream from which they are made. A quality improvement project that is applicable to all dairy products is submitted.

The duties of each of the agencies which should cooperate in carrying out this project are outlined as follows:

Extension Service. (1) Assume active leadership of the project. (2) Obtain the cooperation of all interested agencies. (3) Supply subject-matter material to all county agricultural agents and other concerned. (4) Prepare and distribute to producers of milk and cream information matter dealing with the care of milk and cream on the farm en route to market. (5) Prepare and disseminate, through all available channels, information matter pertinent to this program. (6) Advise dealers and manufacturers as to the tests which they should use for determining quality. Instruct dealers and manufacturers how to conduct and interpret such tests. (7) Get in touch, at the earliest possible moment, with all producers whose milk or cream is of poor quality, as shown by the tests for quality. (8) Advise dealers and manufacturers as to the grading system best adapted to their particular product. (9) Make frequent check on plant operators to see that they are properly conducting the tests for quality and properly grading the milk or cream received. (10) Make frequent check on dealers and manufacturers to ascertain that they are handling and processing their products according to the best known methods. (11) Stimulate and keep up interest.

State Control Officials. (1) Cooperate with the extension service by informing them of the work they are doing. (2) Acquaint all local health authorities with the need, purpose, and scope of this program and enlist their cooperation, particularly in aiding dealers and manufacturers with grading milk and cream, condemnation of low-quality products, and farm inspection. (3) Make frequent inspections of all cooperating plants to see that they are complying with all sanitary regulations. (4) Cooperate with the extension service in checking plant operators to see that they are properly conducting the tests for quality and properly grading the milk or cream received.

Vocational Agriculture. The Board of Vocational Education will take the proper steps to bring this program and its full import to the attention of all teachers of agriculture in the schools of the State and will instruct them to make the teaching of proper care in the handling of milk and cream on the farm, and the stressing of the same, an integral part of their educational work.

Producers Cooperatives. In those areas where there are producers cooperatives their field men should have access to the results of the quality tests in order that they may devote a greater portion of their efforts to aiding the producers of poor quality products.

Dealers and Manufacturers. (1) Conduct tests for determining quality. (2) Furnish results of quality tests to the extension service. (3) Adopt a grading system or at least reject all milk and cream of low quality as shown by the quality tests. (4) Call meetings of producers at direction of extension service. (5) Follow up work with their poor quality producers when possible.

INSTRUCTIONAL SECTION

I1. Trends in Dairy Instruction. C. E. WYLIE, University of Tennessee.

As dairy conditions change on farms and in industry, in addition to the discovery of new processes, equipment, and methods, it is important that methods and materials used in teaching be revised from time to time. The purpose of this study is to present some phases of the dairy instructional work in the Land Grant Colleges together with some trends in instruction. This includes the following:

1. Collegiate and non-collegiate courses.
2. Methods, procedure, and present status of First Elementary Dairy Courses.
3. Methods of conducting senior and graduate courses.
4. Departments represented in dairy instruction.
5. Determining the content of courses.
6. Factors determining the number of courses and students.
7. Instructional trends in instruction, equipment, and personnel.
8. Comments from institutions.

I2. Junior Colleges and Their Influence on Dairy Education. C. L. ROADHOUSE, Division of Dairy Industry, University of California.

During the past 20 years more than 500 junior colleges have been organized in 27 states of this country. The Office of Education of the United States Department of the Interior reports that junior colleges have found a place in American education for the purpose of teaching the traditional freshman and sophomore college courses.

During the past three years at the University of California more than 50 per cent of the students majoring in dairying have come from junior colleges and entered as junior students. The curriculum in junior college is not uniform and the students have not completed all lower division courses required for dairy students. This has interfered with students from junior colleges receiving the full Dairy Industry training during their junior and senior years.

Since few junior colleges offer an elementary course in dairying, upper division work in dairying cannot be taken at the Agricultural College until the second semester of the junior year. This usually interferes with the students enrolling in all the dairy courses offered. Experience has shown that students do not acquire the proper viewpoint of dairying when the dairy courses are crowded into four semesters.

Dairy students should be encouraged to spend at least six semesters in the college or university where their dairy training is secured. In some states junior college students are not permitted to transfer to the college or

university after the freshman year unless they have a high scholarship average.

If high school graduates cannot enter the agricultural college before the junior year, it will usually be necessary that they spend an extra semester or two at college in order to receive the same preparation and viewpoints of the students who enter as freshman.

13. Factors in the Retention of Knowledge. E. N. HANSEN, Dairy Husbandry Department, Iowa State College.

Much emphasis has been given to the acquisition of knowledge, but not very much to the conditions which make for its retention. The modern teacher is anxious to so prepare and give the subject matter that basic facts and principles will be retained by the student and be of use to him in his future work.

There are quite varied opinions among educators as to some of the conditions which affect permanent retention of knowledge. Most of them are agreed, however, that there are three factors of primary importance, namely:

1. Interest in the subject.
2. Understanding of the subject.
3. Subsequent use of it in our thinking or work.

Experiments have been conducted to attempt to learn the importance of these and other factors. In an experiment by the Vocational Education Department at the Iowa State College, final examination questions in courses in Animal Husbandry, Farm Crops, Soils and Physics were given 50 students that had taken the courses two or more years before. Each person taking the examination was not only asked to answer the questions, but also to evaluate each of them on the following points: Interest, Understanding, and Use, as considered by him at the time that he took the course.

It was very evident, from this study, that facts such as dates, yields, names of persons or animals extinct or of minor importance are not retained by the average person. These types of questions also received the lowest rating as to the three points—Interest, Understanding and Use. In the case of many students, a general idea of such type of questions should be sufficient. Exceptions are the cases of students specializing in a certain field of work.

In the study of the four courses, the students retention grades and the actual grades that they had obtained when they took the courses, were compared. They were as follows, on a basis of 100:

	Course 1	*Course 2*	*Course 3*	*Course 4*
Retention Grades	35.0	73.9	71.6	49.57
College Grades	87.3	88.0	89.1	84.7

The scores on the three factors, Interest, Understanding and Use, were in the order of the retention grades, *i.e.*, lowest on Course 1 and highest on Course 2. Two of the ten questions in Course 1 were in regard to giving dates of certain events and three others were on identification of persons or things of minor importance. These five were largely memory questions and gave little chance of making strong connections or thought relationships during the course.

Some people have the ability to think or reason much more highly developed than others. One that has the ability to think can reason out a large number of questions asked, in the case of cause and effect questions. But in case of a strict memory question, nothing can be done if his memory has failed him.

A comparison of the retention grades and college grades shows that college grades may not measure what a person may be able to do with his information later, especially if based on memory questions.

Another experiment at the Iowa State College was in regard to Remembered and Forgotten Facts. Two hundred graduate students were asked to search through old notes or textbooks used in courses which had been taken by them at least two years previously and select six facts which they remembered clearly and six facts which they had completely forgotten. They then scored each of these facts in thirteen diffrent conditions or factors which were suspected by them of being important conditions in securing permanent retention.

The results showed that the three most important factors were: first, interest; second, subsequent use; and third, understanding. It is considered that the factor of associations is included in both subsequent use in thinking and in understanding. Visual impressions and illustrations were important factors.

The experiment brought out that the factors of emphasis by the teacher; learning by repetition; and the requirements by the teacher of attention and hard work are not important in securing retention. It is realized that these factors are important in the acquisition of knowledge but it appears that much of it is soon lost. The subject matter and methods of presentation should be given thorough consideration by the instructor.

I4. Rapid Calculation of Rations by Means of a Pony. P. T. Dix Arnold, Florida Agricultural Experiment Station.

An accurate and rapid method of calculating rations for dairy cows is included as a part of laboratory exercises in the course, "Milk Production," offered in the curriculum of the University of Florida College of Agriculture. A pony sheet is made up by each student in laboratory on heavy ruled paper. Headings used are as follows:

Heart girth and estimated body weight.

Maintenance requirements, by 50-pound classes.

Nutrients required per pound of milk, interpolated by tenths of a per cent in butterfat test.

The reverse side of the pony sheet is arranged to carry the amounts of nutrients provided by each roughage, or concentrate mixture used locally. Each of these is calculated according to the pounds ordinarily used for cows with a commercial level of production, and "Rule of Thumb" feeding practises.

The pony is used as follows:

1. Estimate the live weight of a cow by measuring her heart girth.
2. From the pony sheet, obtain the maintenance requirements to the nearest 50-pound class.
3. Calculate production requirements from daily milk yield, and the appropriate fat percentage column on the pony.
4. The sum of "2" and "3" amounts to the total nutrients required.
5. Estimate the amount of roughage that will be fed, according to "Rule of Thumb." Substract the nutrients provided by these, from the total requirement.
6. The remaining nutrients required, not provided by the roughages, can be seen by a glance at the pony, to be provided by an appropriate number of pounds of the concentrate mixture to be used.

This method is not original with the author, but may be a help to students who later become cow testers, Smith-Hughes teachers, County Agents, or feed salesmen. When advising an inquirer, a quickly-calculated ration commands respect, whereas a delay of 5 to 10 minutes used in the old style long-hand calculation may lose the confidence of the inquirer.

I5. College Creameries. THOS. B. HARRISON AND C. E. WYLIE, University of Tennessee.

Instruction in Dairy Manufacturing in Land Grant Colleges is carried on in almost all States. In order to make a study of this work, a questionnaire was sent to all of these colleges, and questionnaires were returned from 47 States. This material has been assembled and tabulated under the following general headings:

1. Colleges having creameries and the amount of various products handled.
2. The method of disposing of these products.
3. Purchases of raw materials including sources other than university herds.
4. The number, qualifications, and rates of pay of employees.
5. Various methods of financing and handling of creamery funds.
6. Services rendered to the State through creamery operations in addition to instructional work.

I6. A Course in Milk and Public Health. H. O. HENDERSON, West Virginia University.

Need of Course. In the past, our milk inspectors have been recruited from men who have had no previous experience with milk. Some of these had taken courses in Sanitary Engineering, and were using the milk inspecting job as a stepping stone to something better, while many others were appointed because of political or other reasons. They were not interested in being dairy inspectors permanently nor were they capable of so being. The dairymen objected to many of these men because of this lack of interest and knowledge. Many of them were simply machines and could not make any decisions as they were not acquainted with the composition, food value, or fermentations of milk, nor the methods of producing clean milk. There is little wonder that many of the dairymen became antagonistic to the sanitation program. To train men for such jobs, and to give milk inspection the place that it should have, was the primary reason for the organization of the course in Milk and Public Health.

While the training of milk inspectors was the primary object, nevertheless it has proven very popular as an elective course to those students who wish to know something about milk but are not interested in going into a specialized dairy course. It is popular also with the dairy students—both those that are in the production field and those in the manufacturing field.

Content of the Course. The course is given for either 2 or 3 credits depending upon whether the student wishes to take the laboratory or not. The laboratory is strongly recommended for all those that wish to go into the inspection field as they go along closely with the lectures and supplement them very satisfactorily.

The course starts off with a study of milk, its compositions, properties and food value, so that the student will know the importance of milk. The contamination of milk with bacteria, and under certain conditions with disease producing organisms is discussed. This is followed with the methods used to safeguard the milk and to protect the public health. This leads into the discussion of milk ordinances and the duties of milk inspectors, and how one should review the whole matter of milk inspection so that one can have an impartial view of the entire problem.

Result of the Course. While this course has been given for only a few years, the results have been very gratifying. The State Department of Health is now looking to our department for their milk inspectors. Within the last two years, they have taken five district supervisors, and numerous county and city inspectors from those who have taken this course. The dairymen are also much better satisfied and are going along with the sanitation program better than before. Closer cooperation is being had with the extension service and the entire milk inspection movement has been put on a higher plane.

I7. The Desirability of an Advanced Course in Dairy Industry as a Requirement for Agricultural Students. KENNETH M. RENNER, Texas Technological College.

A number of reasons will be advanced for the desirability of requiring an advanced dairy industry course for agricultural students.

Certain trends in the occupations of agricultural college graduates make it highly desirable that they have more knowledge of the dairy industry than is made possible by the usual required, "Elements of Dairying Course."

An increasing number of agricultural college graduates are entering the field of vocational agricultural teaching, county agent work, or other branches of the business where they are placed in an advisory capacity to farmers. Statistics show that approximately one-fourth of the total agricultural income is derived from the sale of milk and its products. This indicates that more farmers are becoming interested in the dairy industry.

A brief discussion of such a course, which has been required at the Texas Technological College for the past five years, will be presented.

I8. Extramural Courses in Dairy Husbandry. H. A. RUEHE, University of Illinois.

The author discusses over twenty-five years of experience in adult education in dairy manufactures. He points out the change from the trade school type of short course which stressed the "how to do" instruction to the conference type of "why we do"; and the later development of the night school type of extra mural course.

The author reports upon the success of an extra mural course given in Chicago this past year with fifty-eight enrolled. The course carried 3 hours of University credit and was open to three classes of students:

1. Those able to meet the regular University entrance requirements.
2. Unclassified students, not able to meet University entrance requirements but who were over 18 years of age and experienced in dairy work.
3. Visitors who paid visitor's fee but who did not receive credit for the course.

The author also points out the demand for advanced extra mural courses in dairy manufactures and instruction of graduate calibre.

I9. Undergraduate Dairy Seminar. A. A. BORLAND, The Pennsylvania State College.

Objects of Course:

1. To teach the student how to educate himself by gathering and assembling all the available information on a given subject.
2. To give a general review of the dairy field of knowledge.
3. To give the student practice in the use of the library.

4. To afford the student practice in public speaking by the oral presentation of a given subject.

5. To teach the student to think for himself through discussion and debate in class.

Plan:

The first meeting is occupied with an explanation of the objects and plan of the course with an explanation of how to find material in the library on a given subject; how to assemble that material properly when found; what an abstract should contain; and what information a reference should give. Sample outlines, including proper arrangement of bibliography are distributed, also a list of subjects selected from recent investigational work of the agricultural experiment stations or commercial organizations. From this list first, second, and third choice may be made of subject to be presented in class by the student at a later date. The subjects are changed from year to year so as to have all topics timely and of real interest.

The subjects chosen are then given consideration by the instructor and one is assigned to each student so that no two have the same topic. A definite schedule is then arranged by the instructor assigning date when student is to submit outline and bibliography to instructor, date when complete write-up is due, and date when subject is to be presented in class.

The first four or five meetings of the class are devoted to a review of the experimental work in dairying at the institution in which the student is enrolled. The assigned subjects are then presented in the remaining periods throughout the semester. Sometimes prominent authorities on particular dairy subjects are also secured for addresses before the class.

In presenting the subject, the student is expected to speak orally for a period of 15 minutes. He may use illustrative material, charts, or tabular material on the blackboard, but must not read his paper. The date when the student is to hand in his outline and bibliography, including a starred reference for study by the whole class, is two weeks in advance of the date of his presentation in class. This material is mimeographed and a copy given each member of the class. The members are then expected to look up the starred reference, so that they will have some general knowledge of the subject when it is presented in class.

The first 10 minutes of the class period are used for a quiz on the present or preceding subject, the next 15–20 minutes by the speaker, and the last 15–20 minutes are devoted to general class discussion of the subject.

The complete write-up of the subject turned in by the student at the meeting prior to presentation in class is also mimeographed and copies distributed at the close of the class period in which the speaker presents the subject. Each student is expected to read over this article and be prepared for a 10 minute quiz on it at the following class period.

By this method each student has an outline, a bibliography, and a complete write-up, not only of his own subject, but also that of every other

member of the class. He thus gets a general review of the up-to-date information in various phases of dairying; he acquires the habit of "self-education" by amassing and assembling in logical order the information available on a particular subject; he receives practice in the use of the library, practice in public speaking, and practice in extemporaneous discussions.

I10. Practical Dairy Industry Experience and the Scholastic Record. E. F. Goss, Iowa State College.

An analysis of the practical plant experience and complete scholarship records to the spring quarter of 1937 of 239 undergraduate students majoring in dairy industry at Iowa State College during the 1936-37 academic year is presented. These men were enrolled in the following four year curricula, Dairy Industry, Dairy Industry and Chemistry, and Dairy Industry and Economics, and in the Two Year Curriculum for Creamery Operators.

Of the 239 students in all six classes 129 individuals or 53.9 per cent had obtained practical dairy experience before enrolling at Iowa State College. Of the students in the 4 year curricula 89 or 52.9 per cent had such experience prior to college entrance while among the two year students those with previous experience totaled 40 and comprised 56.3 per cent of the two classes. The average period of dairy experience prior to college entrance for the entrance group was 22.4 months and for the latter group 26.

An item of interest is the fact that in 61 instances or 25.5 per cent the fathers were or recently had been active in the industry at the time the student enrolled in the college course or in other words these men were second generation dairymen.

Vacation dairy plant experience is considered to be a distinct asset to the student and such experience had been obtained by 95.5 per cent of the senior classes and 100 per cent of the second year creamery operator students.

The scholastic average in all work taken expressed in terms of quality point average up to and including the winter quarter 1937, was 2.21 for those with experience compared with 1.94 for those without practical experience. For the dairy work alone the average for the two groups was 2.41 and 2.14 respectively.

I11. The Placement of Dairy Graduates. M. MORTENSEN, Iowa State College.

Training the Students for Specific Positions. Before a teacher is justified in recommending a graduate for a position he should know that the graduate has had the proper training and is in possession of other qualifications necessary for becoming successful in the particular field in which he seeks employment.

There are, generally speaking, three fields of work for which the college dairy departments prepare their students, namely, research, teaching, and commercial work. The men trained for research and teaching should have a good background in chemistry, bacteriology, physics, and mathematics. They should be willing and interested in taking advanced work leading to the degree, Ph.D. Men trained for the commercial field should be well grounded in economics and have a fair knowledge of chemistry, bacteriology, and mathematics. An additional year of graduate work would be desirable.

Contacting the Prospective Employer. The teacher or the senior counselor should become sufficiently well acquainted with the individual student to determine within a fair degree of accuracy the field for which the particular student is best qualified even to the extent of deciding about specific work within a certain field. There is within the commercial field demand for men of quite varied qualifications, such as sales work, field work, manufacturing, accounting, and for men who have ability to work into executive positions. The teacher should contact such organizations as may possibly be interested in employing men of qualifications as presented.

The teacher should not assume all the responsibility. It is preferable to have the student do the corresponding and have the teacher act as advisor. The successful student must know how to write a business letter, otherwise his application is unlikely to meet with favor. Dairy Industry students should all be required to take a course in business correspondence.

Certain graduates are more or less of the prospector type; they decide on some certain state or location in which they desire to locate and they appear in person applying for a position. A young man of a good personality will have many advantages in applying in person.

Assistance from the Alumni. The alumni are loyal to their Alma Mater. They never forget what the college did for them and they are happy to have a part in placing later graduates. A department keeping in close touch with its alumni will be assisted to an appreciable extent in placing graduates.

The Personnel Department. Most schools maintain a personnel department and the placing of graduates is frequently handled by that department. Since the dairy teachers are generally in close contact with the industry they represent, the placement of graduates can best be handled by the teachers of the dairy department if they all cooperate toward that end.

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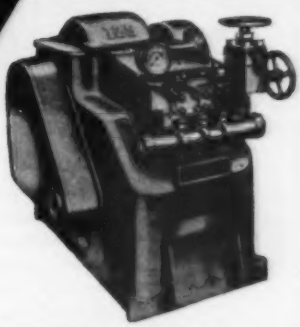

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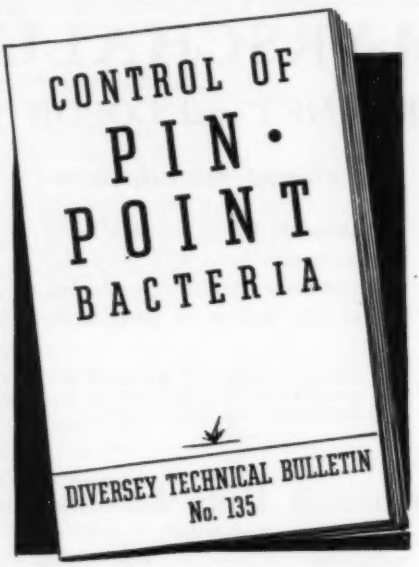

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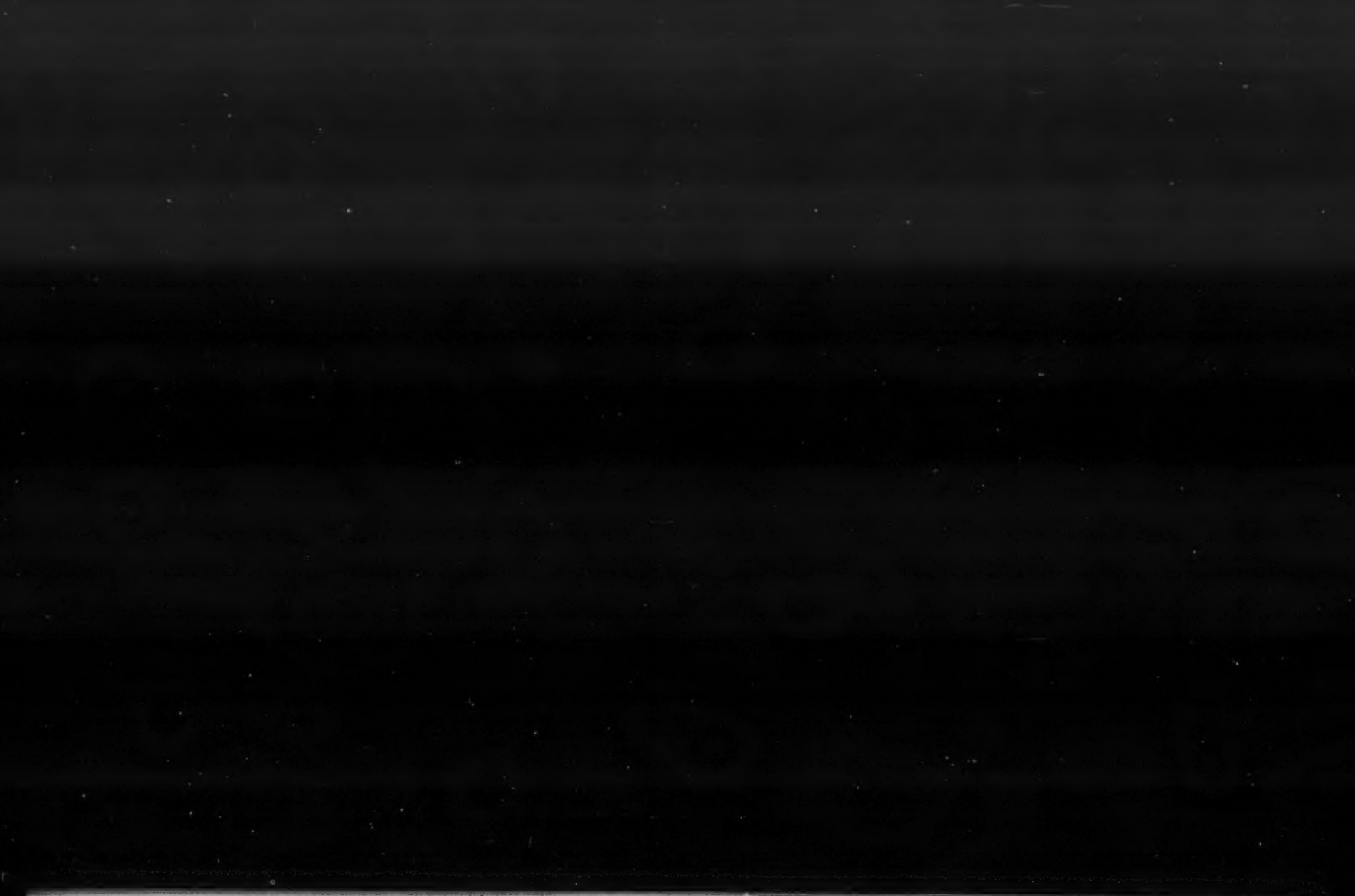

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